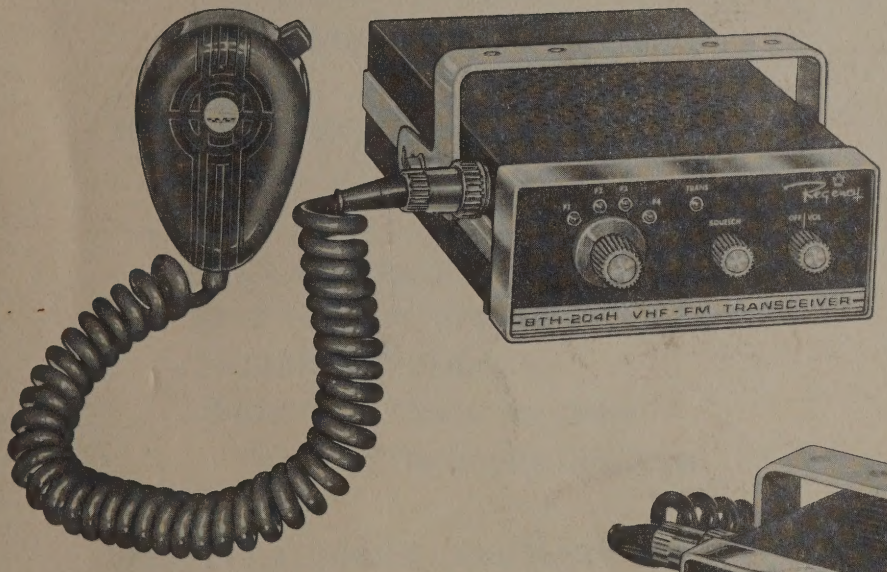
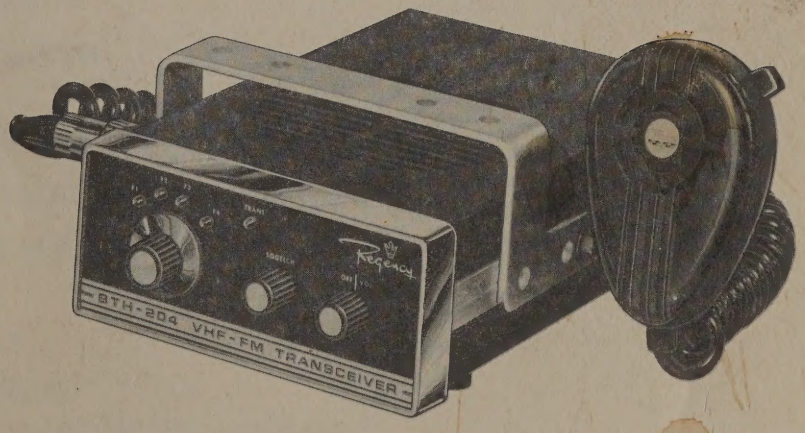
Regency ELECTRONICS INC.

SERVICE MANUAL





MODELS BTH-204 BTH-204H

VHF FM TRANSCEIVER

7707 RECORDS STREET
INDIANAPOLIS, INDIANA 46226

PRINTED IN U.S.A.
11-74

PRICE $5.00
SM - 10 - 515

BTH - 204 AND BTH - 204H SERVICE MANUAL

SECTION 1 GENERAL INFORMATION

1-1 DESCRIPTION

The Regency BTH-204 and BTH-204H are all-transistor, four-channel FM transceivers designed for use in the VHF (150-174 MHz) Communications Band. The BTH-204 operates in the 150-162 MHz segment of the band, while the BTH-204H operates in the 162-174 MHz segment. The transmitter and receiver sections both employ band-pass circuitry for maximum RF power output and receiver sensitivity. Receive and transmit frequencies are both crystal-controlled.

The transmitter and receiver sections can be pre-tuned to any frequency within the specified segment of the band (150-162 MHz or 162-174 MHz). The two sections are independently tuned, thus either one can be tuned to a different frequency (within the proper segment) than the other. However, the maximum frequency spread for the transmitter section is 1 MHz, while the receiver frequency spread is 3 MHz. In other words, the maximum difference between the lowest and highest frequency is 1 MHz for transmit frequencies and 3 MHz for receive frequencies.

The receiver section is a double-conversion, super-heterodyne type receiver. Silicon transistors (13) are utilizes for dependability under widely varying ambient conditions. Also, two Integrated Circuits are used, providing for compactness and circuit reliability. In addition, a ceramic filter is employed in the second I.F. for optimizing performance where numerous channels are active within the same area of the country.

The transmitter section also utilizes silicon transistors (13) throughout. Two ruggedized RF power transistors (BET or Balanced Emitter transistor type) are employed for high power output, which typically is 22 watts. A large, copper heat sink ensures that there is virtually no power drop off during lengthy transmissions. In addition, an SWR Bridge Limiting Circuit provides the necessary protection to the RF power transistors in the event the antenna or its coaxial feedline becomes open or shorted.

The transmitter employs phase modulation for the ultimate in carrier stability. Internal controls are provided for adjusting the microphone gain and for setting the the amount of deviation. The deviation control is adjusted for a maximum of 5 KHz deviation, in conformance with FCC regulations.

The attenuation of spurious emissions from the transmitter, RF power output, frequency stability, performance under highly varying conditions of temperature and battery voltage, and other specifications, all exceed the limits required for Type Acceptance by the Federal Communications Commission.

NOTE: The Regency Type BTH-204 Transmitter is Type Accepted under Parts 21, 81, 89, 91, and 93 of the Federal Communications Commission Rules and Regulations. The Regency Type BTH-204H is

Type Accepted under Parts 21, 89, 91, and 93. The receiver section of both units is Certified under Part 15, Subpart C as required by the FCC Rules and Regulations.

1-2 SPECIFICATIONS

RECEIVER

Antenna Impedance	50 Ohms
Frequency Range (BTH-204)	150.0-162.0 MHz
Frequency Range (BTH-204H)	162.0-174.0 MHz
Channels	4; Crystal Controlled
Sensitivity	0.35 μv (nom.), 20 DB Quieting
Sensitivity Bandwidth	3 MHz
Selectivity	6 DB down, ±7 KHz 50 DB down, ±16 KHz
Image Rejection	45 DB
Spurious Rejections	60 DB
Intermediate Frequencies	1st I.F. -10.7 MHz 2nd I.F. -455 KHz (ceramic filter)
Modulation Acceptance	±7 KHz
Squelch System	"Noise" Operated
Audio Output (3-4 Ω Speaker)	3 Watts @ 10%, or less, distortion; 5 Watts, maximum
FCC Certified	Part 15, Subpart C

TRANSMITTER

Antenna Impedance	50 Ohms
Frequency Range (BTH-204)	150.0-162.0 MHz
Frequency Range (BTH-204H)	162.0-174.0 MHz
Channels	4; Crystal Controlled
Frequency Stability	±.0005% (-30°C to +60°C)
Power Output	20 Watts (min.) @ 13.8 VDC
Power Bandwidth	1 MHz
Power Amplifier Protection	Limiting SWR Bridge Circuit
Spurious & Harmonic Rejection	57 DB (min.)
Emission Designator	16F3
Microphone	Plug-in, hand held; high Z Ceramic
Mike Pre-Amp	FET, with level control (internal)
Modulation	Phase Modulation with Automatic Deviation Limiting
Deviation	Factory adjusted to ±5 KHz; internal adjustment of 0-7 KHz
FCC Type Accepted (BTH-204)	Parts 21, 81, 89, 91, and 93
FCC Type Accepted (BTH-204H)	Parts 21, 89, 91, and 93

POWER

Voltage Requirements	13.8 VDC (nominal)
	11.7V (min.) to 14.9V (max.)
Current Requirements	@ 13.8 VDC
Receive (Squelched)	130 MA.
Receive (Max. Audio Output)	800 MA.
Crystal Heaters (On State)	260 MA. (max.)
Transmit	4.0 Amps (max.)
Fuse Size	5 Amp., 3 AG

SEMICONDUCTORS

Integrated Circuits	2
Silicon Transistors (Total)	26
BET RF Power Transistors	2
Field Effect Transistors	2
Diodes (Total)	15
Varactor Diodes	2
Zener Diodes	3
Signal Diodes	4
Rectifier Diode	1
Light Emitting Diodes (LED)	5

GENERAL

Front Panel Size	5 5/8" x 2 5/16"
Depth (Including Knobs and Rear Panel Connectors)	9 in.
Weigth (Including Microphone and Mounting Equipment)	3 lbs. 13 oz.
Antenna Connector	SO-239
Power Connector	4-pin, polarized
Speaker Size	4 inch, square

1-3 EQUIPMENT SUPPLIED

a. 1 - Transceiver unit
b. 1 - Microphone and Connector
c. 1 - Mobile Mounting Bracket
d. 1 - Mobile Mounting Hardware
e. 1 - Security Bracket
f. 1 - DC Power Cord and Fuse
g. 1 - Owner's Instruction Manual

1-4 EQUIPMENT NOT SUPPLIED

a. 1 - Antenna
b. 1 - Coaxial Cable feedline

c. 1 - Coaxial Cable Connector
d. 1 - Power Supply (battery)
e. 1 - Pad Lock (used with Security Bracket)

1-5 INSTALLATION

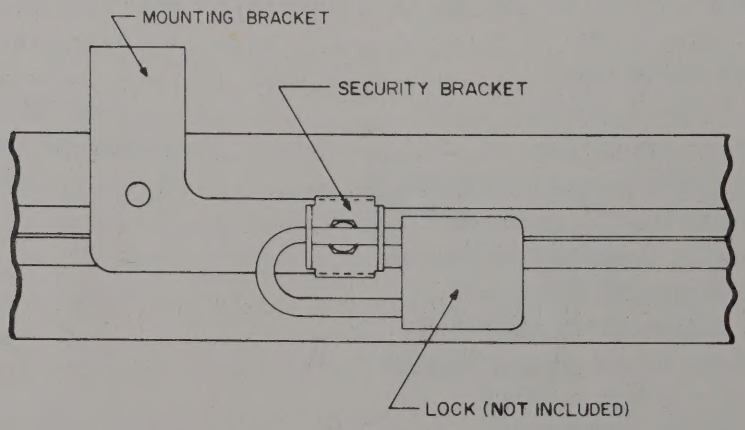
Mobile (12 VDC) Installation:

The BTH-204 or BTH-204H transceiver is designed for installation in any vehicle that has a 12 VDC negative ground system. The RED lead, with the fuse holder, must be connected to the POSITIVE (+) terminal side of the battery. The BLACK lead should be connected to the NEGATIVE terminal side of the battery, or to a metal chassis that is grounded to the negative terminal. In the event that the battery is remotely located, it may be necessary to install additional wires for properly connecting the radio to the battery's terminals.

THE ANTENNA USED SHOULD BE PROPERLY ADJUSTED FOR THE 50 OHM OUTPUT OF THE TRANSMITTER, A HIGH SWR WILL REDUCE THE POWER OUT, OR MAY EVEN SHUT OFF THE TRANSMITTER ENTIRELY.

To reduce the possibility of theft, the Security Bracket should be installed as shown in Figure 1-1. The padlock used should be of substantial construction and can be either a key of combination operated type.

An external (or remotely mounted) speaker can be used by first opening the link between terminals No. 1 and No. 2. Then, connect one lead of external speaker to the terminal No. 4 (chassis ground) and the other lead to terminal No. 1. The use of a 3 to 4 ohm speaker is recommended for optimum performance (such as Regency's MA-8).



SIDE VIEW SHOWING SECURITY BRACKET INSTALLATION FIG. 1-1

1-6 OPERATION

The OFF-ON switch is an integral part of the VOLUME control. Turning this control fully counter-clockwise until a click is heard will turn the unit off. Maximum volume, or audio output, occurs when the volume control is turned fully clockwise.

The receiver's audio is squelched off when the SQUELCH control is turned COUNTER-CLOCKWISE. Turning this control counter-clockwise until the noise just disappears (threshold squelch) permits the receiver to be "quiet" until an actual signal is received. With the squelch control set fully counter-clockwise, the receiver will still operate properly and will not be locked-out (prevented from responding to a received signal).

The transceiver is capable of two-way communications on any one of four discrete, crystal-controlled frequencies, or channels. Selection of the desired channel is accomplished by turning the CHANNEL SELECTOR knob to the desired Channel (F1, F2, F3, or F4).

Below each channel designation (F1 for example) is an LED which glows whenever that particular channel is selected. These lamps make it easy to tell at a glance which channel has been selected and to also verify that the radio is turned on. The remaining LED, labeled TRANS, is a Transmit Indicator which glows whenever the transmitter is keyed (activated).

A high impedance ceramic microphone is supplied with the unit. To install the microphone on the unit, insert the connector plug into its socket with the locating tab toward the bottom of the radio. The connector is then locked into place by rotating the locking ring 1/4 turn clockwise.

To transmit a message, it is only necessary to press the push-to-talk button on the microphone and speak into the microphone. The Transmit Indicator will come on to signify that the transmitter is activated. Best results are obtained by holding the microphone about one inch from the lips and inclined at about a 30 degree angle away from the face. Speak clearly in a normal tone of voice across the face of the microphone.

1-7 CRYSTAL SPECIFICATIONS

Miniature plug-in crystals are utilized by both the receiver and transmitter sections. Because of the high accuracy (close tolerances) required, Regency crystals are recommended. Either receive or transmit crystals must be ordered by specifying the Channel Frequency and Part No. 2311-0000-000 for Receive or Part No. 2312-0000-000 for Transmit. Use of other manufacturers' transmit crystals may cause violation of the FCC Rules and Regulations.

If desired, the RECEIVE crystals may be purchased from other manufacturers. The following specifications must be included in the order:

a. Crystal Frequency, determined as follows:

$$\text{Crystal Frequency} = \frac{\text{Receive Frequency} - 10.7\ \text{MHz}}{3}$$

EXAMPLE:

$$\text{Crystal Frequency} = \frac{156.300\ \text{MHz} - 10.700\ \text{MHz}}{3}$$

Crystal Frequency = 48.533 333 MHz

b. Frequency Tolerance of .001% @ 25°C; .002% from -10 to +60°C

c. 3rd Overtone

d. Series resonance minus 600 Hz

e. Maximum equivalent series resistance of 35 ohms

f. Drive level of 2 MW (max.)

g. Holder: HC-25/U

1-8 CRYSTAL INSTALLATION

Prior to installing a crystal, the transceiver's cover will have to be removed. To remove this cover, unscrew the two large bolts located at the sides of the unit. The cover may then be slipped off by sliding it toward the rear of the unit.

Next, the speaker should be removed. Unscrew the two small metal screws (one located on each side) holding the speaker mounting brackets in place. Then carefully place the speaker assembly along side of the unit.

See Figures 1-2 and 1-3 for proper Crystal Location and Installation. Insert the Receive crystal in the proper channel; be sure the crystal is firmly seated in the socket pins.

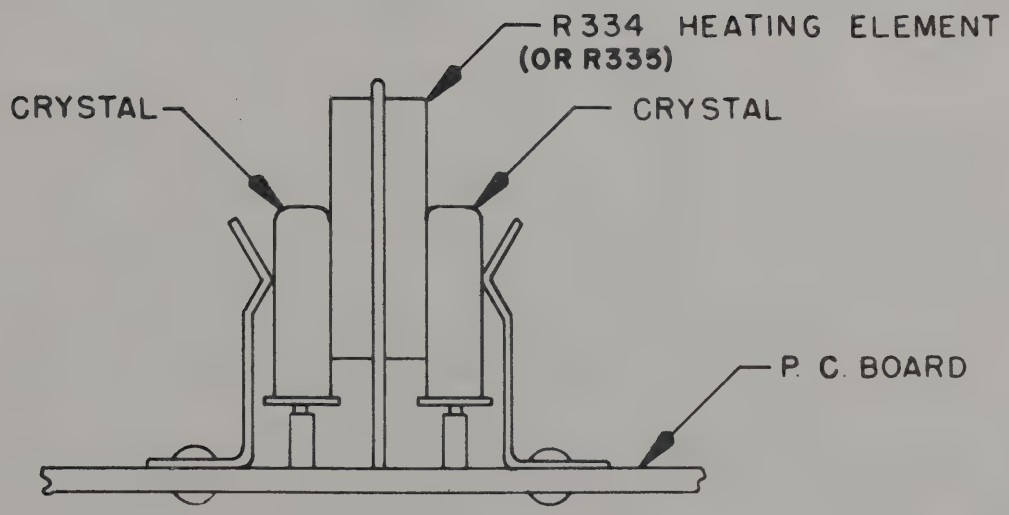
Special care must be taken to install the TRANSMIT crystal, correctly. The conduction type crystal heater, which is used to heat the crystals at a very low ambient temperature, relies on having proper physical contact between the heater element and the crystal for effective operation. The Crystal Heater Detail (Figure 1-2) demonstrates the correct method of crystal installation. The crystal must be pressed down into the socket pins far enough for the rim around the bot-

tom of the crystal to clear the heating element and allow good contact between the side of the crystal and the element.

For the TRANSMIT crystal, there is a variable capacitor that is to be used for "Netting" (adjusting to the exact frequency) purposes. This netting should be made with an accurate frequency counter, such as Regency EC-175. See 3-8 for detailed Crystal Netting Procedure.

NOTE: FCC Regulations require that the TRANSMIT crystal be installed and adjusted "on frequency" under the supervision of a technician holding either a First or Second Class FCC license.

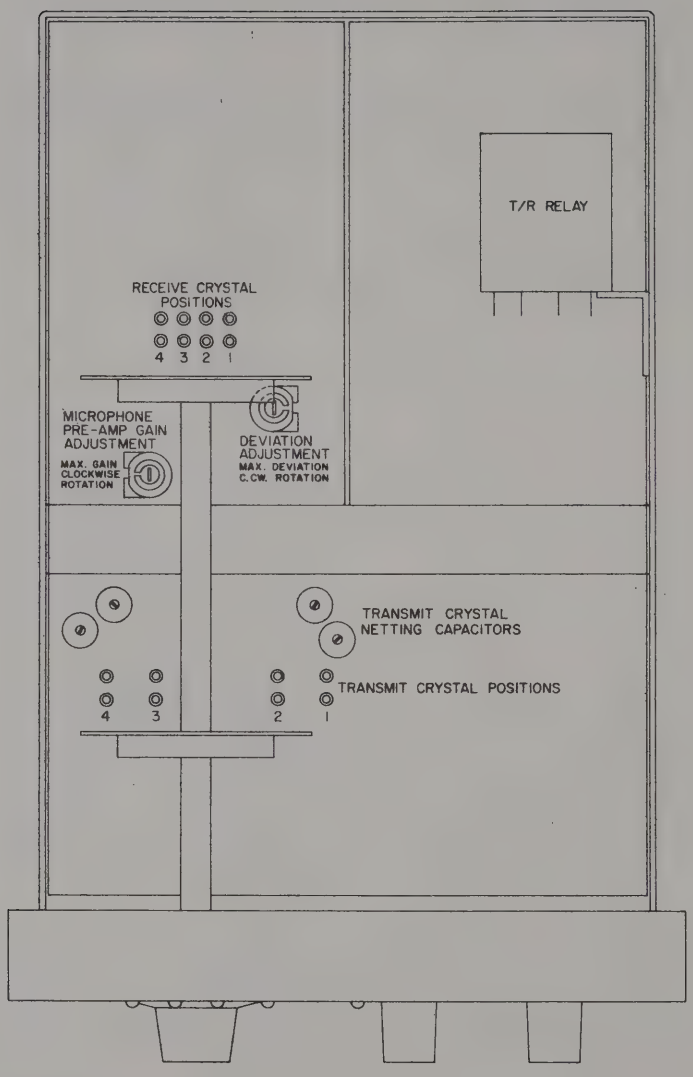
After the crystals are installed, and netted, reinstall the speaker assembly. Then, carefully reinstall the cover and its hardware.



CRYSTAL HEATER DETAIL

(As Viewed From the Front of the Unit)

FIG. 1-2



CRYSTAL LOCATION DIAGRAM FIG. 1-3

SECTION 2 CIRCUIT DESCRIPTIONS

2-1 RF - MODULATOR BOARD

Q201 is an RF amplifier with broad-band tuned circuits in its input and output circuitry. The output of the RF amplifier is coupled to the input of the mixer, Q202, a Field Effect transistor.

The first L.O. (local oscillator), uses third overtone crystals. (The number marked on the crystal is the receive frequency). Oscillator injection to the mixer is accomplished by mutual coupling between the windings of T201.

The 10.7 MHz output frequency from the FET mixer is selected by T202. This output is link-coupled to T101, the IF input tuned circuit.

The Modulator Section of this board is described in 2-4 in conjunction with the transmitter board.

2-2 IF - AUDIO BOARD

The IF input circuitry consists of T101 and Q101, used as an IF amplifier. The output of this amplifier is fed to an Integrated Circuit, IC101, which contains the second mixer and L.O. circuitry, operating at 10.245 MHz. In some locations where a strong secondary Image Signal has been encountered, this oscillator's frequency is moved to 11.155 MHz. (The crystal frequency is stamped on the top of the crystal).

The 455 KHz output of IC101 (terminal 5) is coupled through a tuned circuit to the input of the ceramic filter, CF101. CF101 is a narrow-band filter centered at 455 KHz. The excellent band-pass characteristics of CF101 provide for very good adjacent channel rejection. The output of CF101 is coupled through another tuned circuit to the input of Integrated Circuit IC102. IC102 is a series of amplifiers providing approximately 60 DB gain at 455 KHz. Also included in IC102 is the limiting circuitry and a quadrature detector circuit. L103, connected between terminals 2 and 12 of IC102, is the adjustable quadrature coil.

The audio output from IC102 (terminal 1) is coupled to the input of the audio amplifier circuit and to the input of the noise-operated squelch circuit.

Transistor Q102 is an amplifier whose frequency response extends from approximately 5 KHz to 25 KHz. Q102 amplifies the "noise" occuring in this frequency range. The noise is coupled to the base of Q103. Q103 is used as a detector which rectifies the amplified noise and produces a DC voltage at its collector. When the DC voltage at the collector of Q103 is positive and of sufficient value to provide base bias for Q104, Q104 turns on and provides essentially a short circuit between the base of Q105 and ground. This action turns off Q105 and the audio output from the receiver is squelched (muted).

When a signal (carrier) arrives, the noise input to the detector (Q103) is reduced to the point where the DC voltage at the base of Q104 is no longer sufficient to cause Q104 to conduct.

At this time, the audio pre-amplifier (Q105) is allowed to operate normally and its audio output is applied through the volume control to the base of the audio amplifier, Q106. Q106 supplies a signal to the audio driver transistors, Q107 and Q108. The output transistors, Q109 and Q110, form a quasi-complementary, transformerless stage capable of delivering 5 watts to the speaker.

2-3 LED DISPLAY BOARD

Channel Indicator:

When a particular channel is selected, the cathode of that channel's LED indicator (LD401, 402, 403 or 404) is grounded and voltage to the LED is provided by the transceiver's supply voltage.

Transmit Indicator:

The Transmit Indicator (LD405) functions similarly, except that the cathode is already grounded and voltage to the LED is provided by the transmitter supply voltage.

2-4 TRANSMITTER BOARD

Q308 is in a crystal oscillator circuit operating at approximately 13 MHz. Each crystal has a trimmer capacitor in series with it. This trimmer capacitor is used for fine (small) adjustments to the crystal's frequency.

The crystal heater assembly consists of R334 (or R335) and two spring clips. R334 (or R335) is located between two crystals in such a manner that the spring clips force the crystals into reliable physical contact with this resistor. Power dissipation in the resistor is sufficient to cause conduction heating of the crystals to above $0^{o}C$ when the ambient temperature is $-30^{o}C$. Control circuitry consisting of Q309, Q310 and associated circuitry automatically adjusts the power delivered to the crystal heaters. Heater turn-on is nominally between $0^{o}C$ and $-5^{o}C$. Both heaters will be completely shut off at normal ambient temperatures. Refer to Figure 1-2 for detailed drawing.

The oscillator's frequency is phase-modulated by two varactor diodes, CR302 and CR303, which are connected across a coil (L306) that is lightly coupled to the emitter circuit of the oscillator. L306 is tuned to the crystal frequency. The oscillator's phase-modulated output is applied to the base of Q307. Q307 is a multiplier whose output frequency is three (3) times the crystal frequency. The

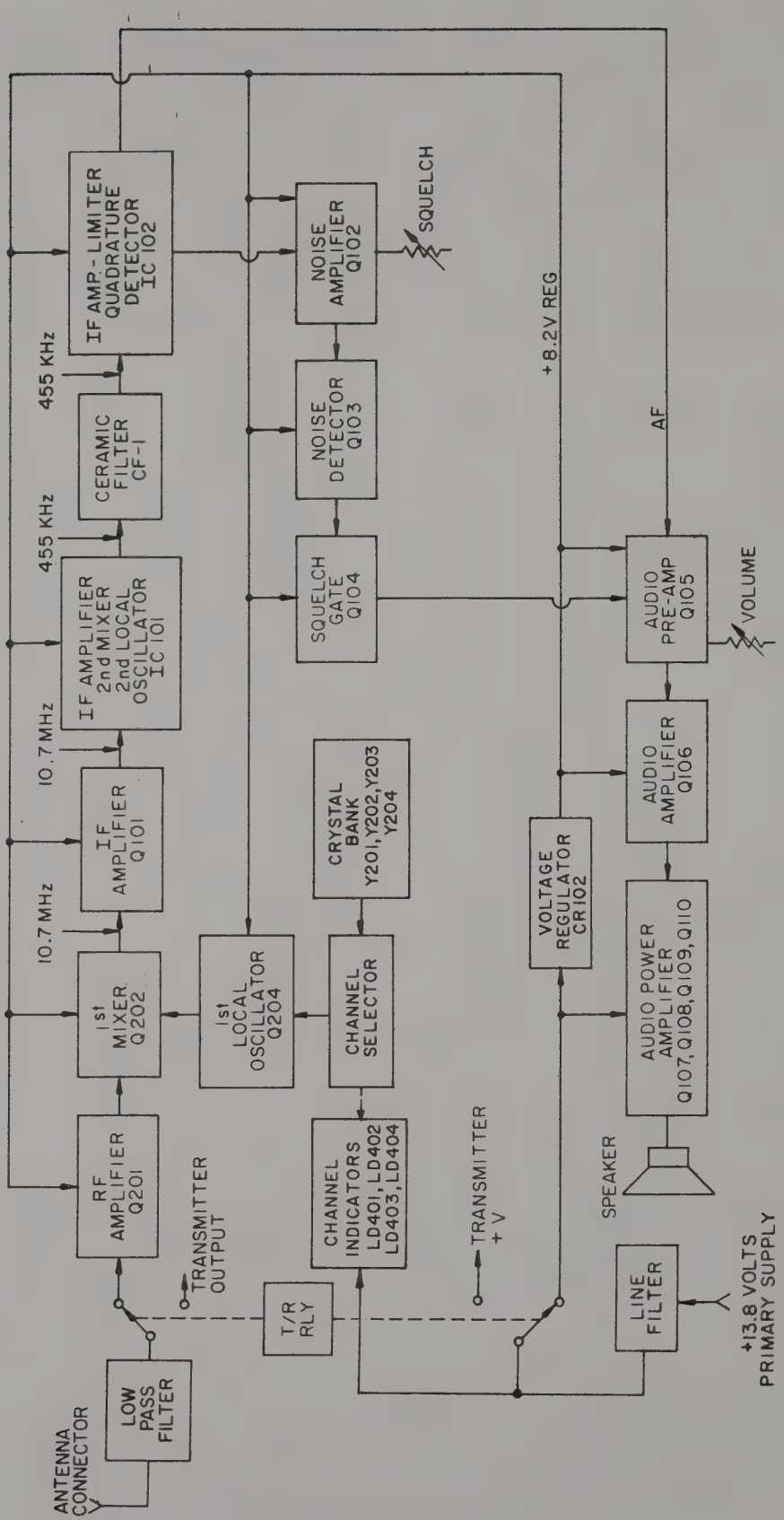
signal from Q307 is transformer coupled to the base of Q306. Q306 is used as a doubler, a stage that multiplies its input signal's frequency by two. Thus, the output frequency of Q306 is six (6) times the crystal frequency. This signal is then applied to Q303, which is also operating as a doubler. The frequency of the output signal from Q303 is twelve (12) times the crystal frequency. This frequency is the ultimate transmitter output frequency.

Q302 is a power amplifier operating "straight through". Q302 provides the drive (RF signal) required by the "final" stage, Q301, to deliver at least 20 watts of RF power to the antenna through the impedance matching network in its collector circuit. Q301, Q302, and Q303 operate in the Class C Mode.

The transmitter output transistor, Q301 is protected from damage due to excessive SWR on the antenna transmission line by the SWR Bridge and Drive Limiter circuits. In the event of a load mismatch at the antenna connector, the SWR Bridge consisting of T301, R301, R305, and CR301 will detect the mismatch and send a signal to the Drive Limiter. The Drive Limiter (Q304 and Q305) will then bias Q306 in an off condition, preventing possible damage to the power amplifier (Q301). Load mismatch is detected by comparing the phases of output voltage and current to determine if standing waves exist on the feedline to the antenna.

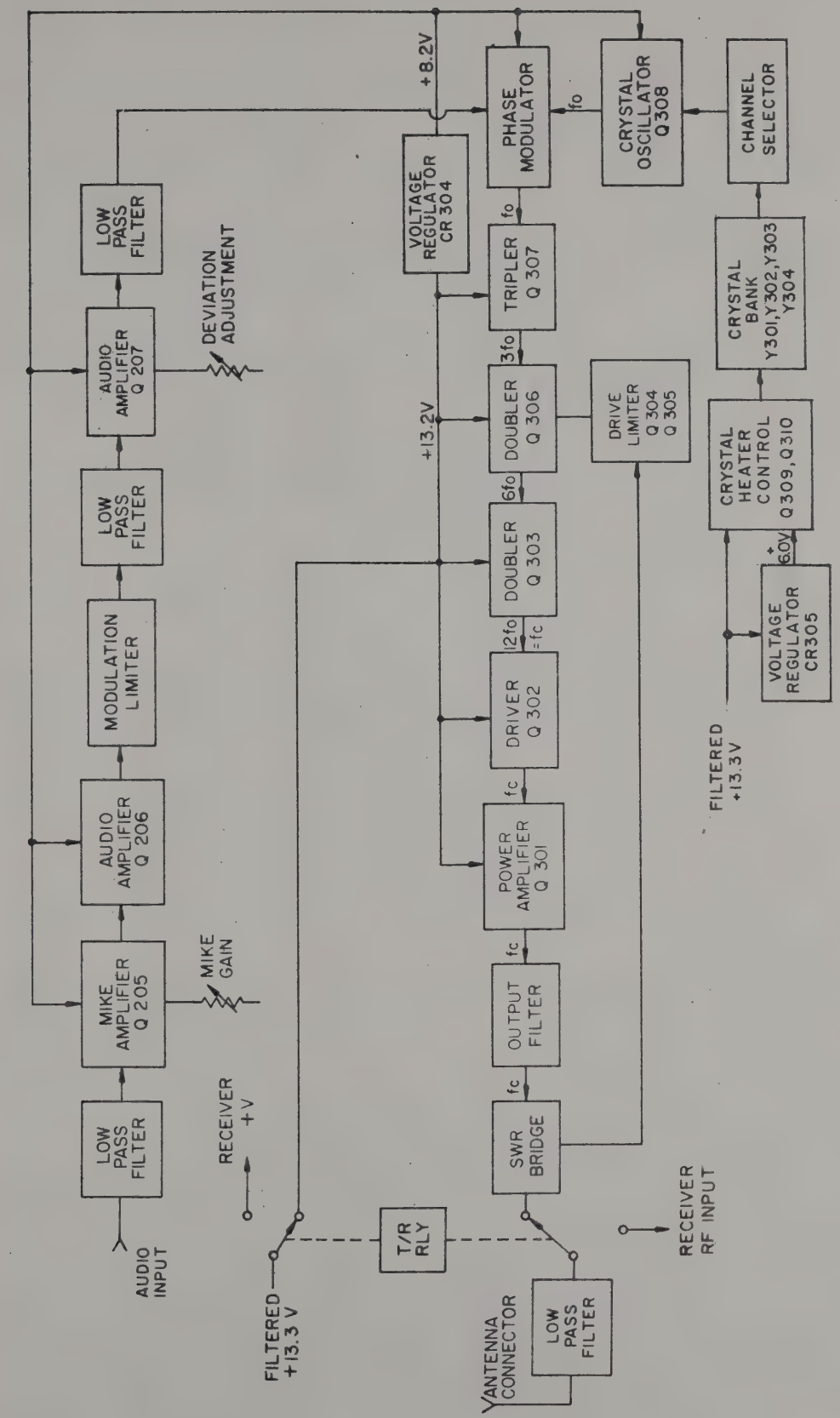
The modulator section of the transmitter uses a high impedance ceramic microphone. The microphone signal is applied to a Field Effect transistor, Q205. The output of Q205 is applied through the microphone gain control (R217) to Q206. The mike gain control is adjusted to compensate for the output differences in the voice levels of various operators and will normally be set at about 75% of maximum clockwise rotation. This control sets the mike signal to the proper clipping level for the logarithmic clipper diode circuitry between stages Q206 and Q207. Suitable pre-emphasis and de-emphasis is used preceding and following the diode clippers. The deviation control (R228) in the collector circuit of Q207 sets the level of the audio signal voltage applied to the Varactor diode modulator circuit. This level is adjusted for a maximum of 5 KHz deviation with the clippers driven to full clip by a 1 KHz audio signal.

The push-to-talk (PTT) Switch in the microphone applies a ground to the transmit-receive relay coil, which activates the relay. The T-R relay switches the supply voltage between the receiver and transmitter and switches the antenna between the receiver input and the transmitter output.



2-5 RECEIVER BLOCK DIAGRAM

TRANSMITTER BLOCK DIAGRAM



2-6 TRANSMITTER BLOCK DIAGRAM

SECTION 3 ALIGNMENT AND TUNING PROCEDURES

3-1 EQUIPMENT REQUIRED - RECEIVER ALIGNMENT

3-1-1 FM Signal Generator
3-1-2 Oscilloscope
3-1-3 AC VTVM
3-1-4 Noise Generator (To Be Used In 3-5 Only)
3-1-5 Audio Generator -HP 200D or Equivalent
3-1-6 Frequency Counter - Regency EC-175 or Equivalent

NOTE: During all steps of alignment, the squelch control should be in the maximum clockwise position (minimum squelch action).

All transceivers should be aligned to the channel nearest the center of the frequency range over which they will operate.

Diagrams 4-1 and 4-3 show the location of all coils to be adjusted.

3-2 QUADRATURE DETECTOR ALIGNMENT

3-2-1 Connect the FM Signal Generator to the antenna input jack. Accurately set frequency to the center of the channel being used for alignment. Modulate Signal Generator with 1000 Hz, 3 KHz deviation.

3-2-2 Connect the oscilloscope to Test Point A, (Junction of C126, C128, R113). See Diagram 4-4.

3-2-3 Adjust output of Signal Generator until all noise in scope pattern just disappears.

3-2-4 Adjust L103 for maximum peak amplitude, while maintaining symmetry of the detected signal.

3-3 IF ALIGNMENT

3-3-1 Disconnect RF Signal Generator from antenna input.

3-3-2 Connect AC voltmeter across speaker terminals.

3-3-3 Adjust volume control for 0.5 volt noise reading on AC voltmeter.

3-3-4 Peak T102 (bottom core and top core, in that order) for maximum noise (maximum meter reading on AC voltmeter). If circuit is not badly misaligned, the correct point should be within two turns of the cores' present position.

NOTE: Coils will have two peaks; adjust core to peak away from the center of form.

3-3-5 Adjust volume control for 1.0 volt noise reading on AC voltmeter.

3-3-6 Connect the R.F. Signal Generator to the antenna input jack. Turn modulation off. Set the generator to the operating crystal frequency.

3-3-7 Adjust the Signal Generator output until the voltmeter reads 0.2 volts.

3-3-8 Adjust T101, T202, T201 (bottom core) and T201 (top core), (in that order), for maximum quieting (lowest meter reading). Adjust Signal Generator to maintain reading on AC voltmeter between 0.1 and 0.2 volts. If two peaks occur, use the one away from the center of the coil form.

3-3-9 Set the generator frequency to the secondary image frequency. This is 910 KHz BELOW the channel frequency.

NOTE: If the second oscillator is at 11.155 MHz, the secondary image frequency is 910 KHz ABOVE the channel frequency. Check the frequency marked on top of Y101 (10.245 MHz for BELOW and 11.155 for ABOVE).

3-3-10 Adjust the Signal Generator output until voltmeter reads 0.2 volts.

3-3-11 Adjust T102 (bottom core), T102 (top core), T101 and T202 (in that order) for maximum quieting degradation (highest meter reading). Adjust Signal Generator output to maintain voltmeter reading between 0.1 and 0.2 volts. The correct position for the cores should be within two turns of the position in Step No. 4 and 8.

3-4 RF ALIGNMENT (RECEIVER)

3-4-1 Pre-Set the cores of L201, L202, L203 flush with the tops of the coils forms.

3-4-2 Connect AC voltmeter across the speaker terminals.

3-4-3 With nothing connected to the antenna input, adjust the volume control until AC voltmeter reads 1 volt of noise.

3-4-4 Connect Signal Generator to antenna input jack. Set generator accurately to the center frequency of the channel being used for alignment. Turn modulation off.

3-4-5 Adjust output of Signal Generator until AC voltmeter reads 0.2 volts.

3-4-6 Adjust L201, L202 and L203, in that order, for maximum quieting (lowest meter reading). Adjust Signal Generator output to maintain voltmeter reading between 0.1 and 0.2 volts. Repeat adjustments until no further improvements can be made. If two peaks occur on any core, use the peak with the core nearest the top of the coil form.

NOTE: The following step may be omitted if performed in IF Alignment section.

3-4-7 Adjust T102 (bottom core) and T201 (top core), in that order, for maximum quieting (lowest meter reading). Adjust Signal Generator to maintain reading on AC voltmeter between 0.1 and 0.2 volts. If two peaks occur, use the one away from center of the coil form.

3-5 NOISE BALANCE ADJUSTMENT

NOTE: This adjustment may be required only if excessive "ignition noise" is encountered. Usually, the noise problem is caused by improper or inadequate noise suppression of the vehicle's ignition system.

3-5-1 Using a "T" connector, connect the FM Signal Generator and the Noise Generator to the antenna input jack. If a "T" connector is not available, connect the FM generator to the antenna jack and feed in the noise signal by means of a 3 or 4 turn loop coupled to the input coil, L201.

3-5-2 Connect the oscilloscope to the junction of Q109's emitter and Q110's collector, or to the speaker terminals.

3-5-3 Apply a 3 to 10 microvolt signal, as accurately as can be set to the exact channel frequency (carrier only, no modulation), and adjust the output of the Noise Generator until spikes are clearly seen in the audio output as viewed on the oscilloscope. The noise spikes will either mostly be positive or negative if an unbalanced condition exists.

3-5-4 Tune L103 (Quadrature Detector Coil) until the noise spikes are equally positive or negative in their amplitude. The overall amplitude of these spikes should be much less as balance is achieved. Usually, only a 1/4 turn, or less, is needed to obtain the proper adjustment for best noise balance. If a proper balance can not be achieved, repeat the IF and RF alignments and then try the noise balance adjustment again.

3-6 EQUIPMENT REQUIRED - TRANSMITTER ALIGNMENT

3-6-1 RF wattmeter (or equivalent device which provides a 50 ohm load at the appropriate power range).

3-6-2 Frequency Counter - 170 MHz preferred; 50 MHz acceptable.

3-6-3 FM Modulation Meter - Lampkin 205A or equivalent peak reading deviation meter,

3-6-4 Audio generator - HP 200D or equivalent.

3-6-5 VTVM

3-6-6 Oscilloscope

3-7 TRANSMITTER TUNING PROCEDURE

NOTE: The encircled numbers on diagram 4-9 correspond to the LAST digit in the following procedure steps. The unit must be connected to a suitable 50 ohm load for proper alignment of the final transmitter stage.

3-7-1 Install crystals. For full bandwidth alignment, a center tune-up crystal must be used. Alignment is done on the center tune-up frequency and then the bandwidth is checked using the high and low crystals. The total maximum bandwidth for Transmitter operation is 1.0 MHz (500 KHz above and 500 KHz below the tune-up frequency).

3-7-2 Tighten trimmer capacitor C303.

3-7-3 Set the "Netting" capacitors (4 trimmers; see diagram 4-10) to mid-range.

3-7-4 With the transmitter keyed and the tune-up frequency crystal operating, voltage at this point should be 2.5 to 3.0 volts as read on a VTVM.

3-7-5 Move the VTVM's probe to this point and adjust L306 for a maximum reading (1.8 to 2.0 volts).

3-7-6 Move the VTVM's probe to this point. Alternately peak the upper and lower cores of T305 for a maximum reading (normally 1.5 to 2.0 volts; however, if T304 is completely detuned, this voltage can be as high as 4.0 volts). Check this reading at the lowest and highest crystal frequencies installed for proper bandpass alignment.

Repeat steps 3-7-5 and 3-7-6 until no further improvement can be made. After these adjustments have been made, L306 and the primary (bottom core) of T305 should not be changed during the remainder of the alignment procedure.

NOTE: The frequency of the oscillator will change slightly whenever L306 and T305 are adjusted. Therefore, if the adjustment of these parts is ever changed, it is important to perform the Crystal Netting Procedure, 3-8.

3-7-7 Set the top core (secondary) of T304 flush with the top of the coil form. With the VTVM probe on T.P. 6, adjust the lower core (primary) of T304 for a minimum voltage. This dip will be fairly sharp and will reduce the voltage at T.P. 6 to approximately 1.5 volts. Move the VTVM probe to T.P. 7. Adjust the top core of T304 downward until the voltage on T.P. 7 increases to 0.5 to 0.6 volts. If a peak in RF power output is reached before this voltage is 0.6 volts, leave the top core tuned to the power peak. Under no circumstances should the top core of T304 be tuned further down in the coil form than the point where T.P. 7 is 0.6 volts.

3-7-8 With VTVM probe on T.P. 8, adjust the lower core (primary) of T303 for a minimum voltage. Adjust the top core (secondary) of T303 for maximum power output on the wattmeter. During Power Amplifier alignment, the secondary of T303 is retouched for maximum power. At that time, the voltage at T.P. 7 should be rechecked and the top core of T304 readjusted, if necessary, as in 3-7-7 above.

NOTE: If the Power Amplifier Stage (Q301) is detuned to the extent that no power indication can be obtained, the following procedure can be used to set the top core of T303 near its correct position: move the VTVM's probe to Test Point 8. Adjust the top core of T303 for a MINIMUM voltage at this point. Now procede with 3-7-9 and the rest of the Tuning Procedure. With the transmitter delivering rated output power, the voltage drop across R329 will normally be 0.9 to 1.2 VDC.

3-7-9 Set the core of T302 to the center of the coil winding.

3-7-10 Power Amplifier Alignment

NOTE: It is desirable, during Power Amplifier Alignment, to place the unit, especially the transmitter section, on a sheet of steel to simulate the presence of the unit's cover. This sheet should be large enough so that it completely covers the bottom of the transmitter board and protrudes beyond the chassis on both sides. Do

not permit this sheet to touch any part protruding below the transmitter board.

a. Set C303 almost tight.
b. The following adjustments are peaked in the order listed for maximum power output as indicated on the R.F. wattmeter.

1.) Peak C303
2.) Peak C308
3.) Repeat the above two steps until no further improvement is noted
4.) Repeak the top core of T303 (secondary) as in 3-7-8 above.

Check bandwidth with low and high frequency crystals. Adjust T303 for best output compromise between high and low crystals. Adjusting the core of T302 will sometimes help widen the bandwidth or increase power output. C308 is the final adjustment for best compromise over the frequency range.

3-8 CRYSTAL NETTING PROCEDURE

NOTE: The following procedures should be performed with the unit at a temperature of 70 to 80°F. The frequency of each channel must be set to within ±.0001% of the assigned channel frequency. The crystal heater should not be in operation at this ambient temperature. Check to make certain that it is turned off before proceeding further with crystal netting. The voltage drop across R334 (or R335) is zero volts when the crystal heater is off. A useful operational check (after the crystals are netted) is to spray RT-301 with a "cold" spray, lowering its temperature below the heater's turn on point of approximately 30°F. When this is done, the crystal heaters should turn on, as evidenced by Q310 being saturated (low collector voltage).

3-8-1 Use the following procedure if a 170 MHz Counter is available:

a. Connect the unit to the RF wattmeter or dummy load.
b. Turn transmitter on (key the mike's PTT switch or ground pin No. 2 of J2).
c. Place an RF pick-up loop consisting of 3 or 4 turns near the final transistor's output circuit (near L301: see diagram 4-7).
d. Read the frequency on the counter.
e. Adjust the appropriate netting capacitor (C335, C337, C339, C341; see diagram 4-7 for their location) until the frequency being read on the counter is "ON" channel.

3-8-2 Use the following procedure if only a 50 MHz Counter is available:

a. Connect the unit to the RF wattmeter or dummy load.
b. Turn transmitter on.
c. Place an RF pick-up loop near the top of coil T305.

NOTE: Due to a possible slight "pulling" of the crystal's frequency, couple the pick-up loop as lightly as possible to the top coil of T305. Coupling to the bottom coil will prevent a proper crystal netting adjustment from being made. FCC Regulations may be violated if an improper netting adjustment is made. Use the maximum sensitivity available at the counter's input.

d. Multiply the frequency read on the counter by four (4) to find the ultimate frequency being transmitted.

EXAMPLE: Frequency read = 39.200 00 MHz
Ultimate Frequency = 4 x 39.200 00 = 156.800 MHz

e. Adjust the appropriate netting capacitor until the frequency being read is within the required tolerance at one-fourth (1/4) of the ultimate transmitted frequency.

EXAMPLE: Ultimate Frequency = 156.800 MHz
Counter Reading = $\frac{156.800 \text{ MHz}}{4}$ = 39.200 00 MHz ±.0001%

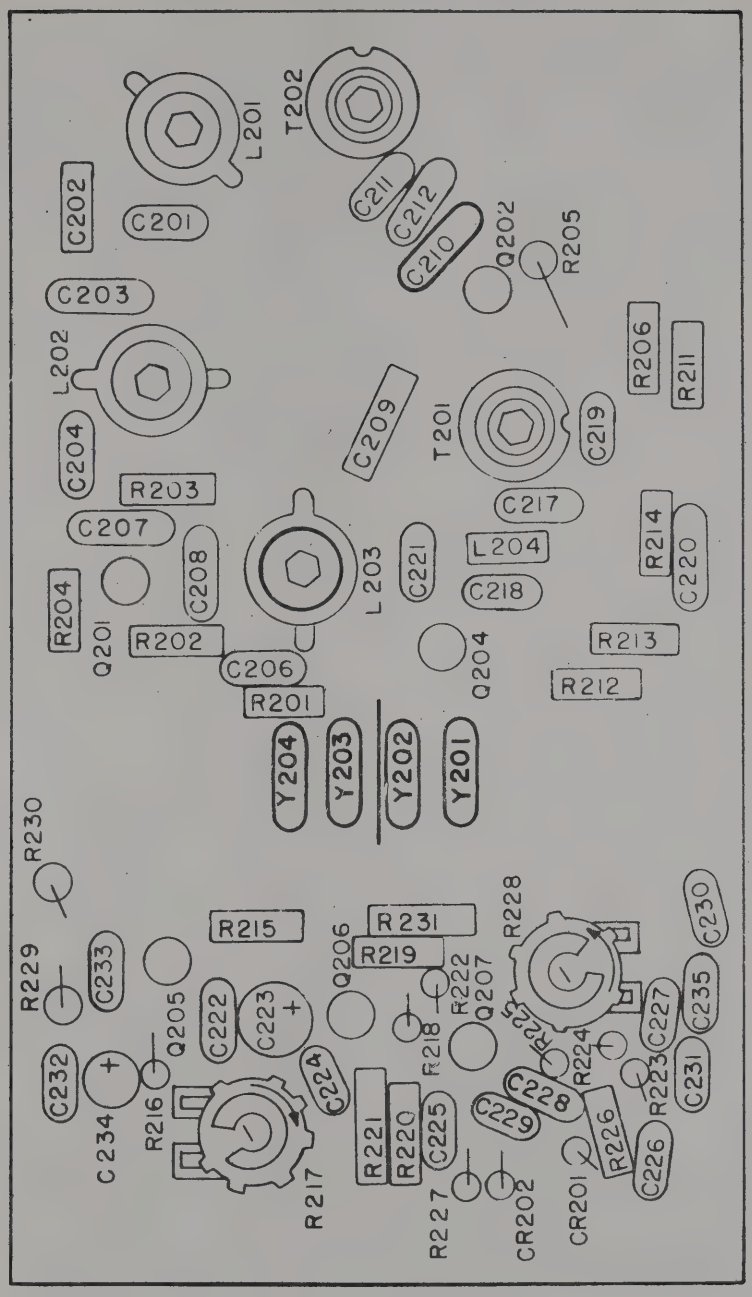
3-9 DEVIATION AND MIC GAIN ADJUSTMENT

3-9-1 Use the following procedure for proper adjustment of the Mike Gain (R217) and Deviation (R228) controls (see diagram 4-10 for their locations):

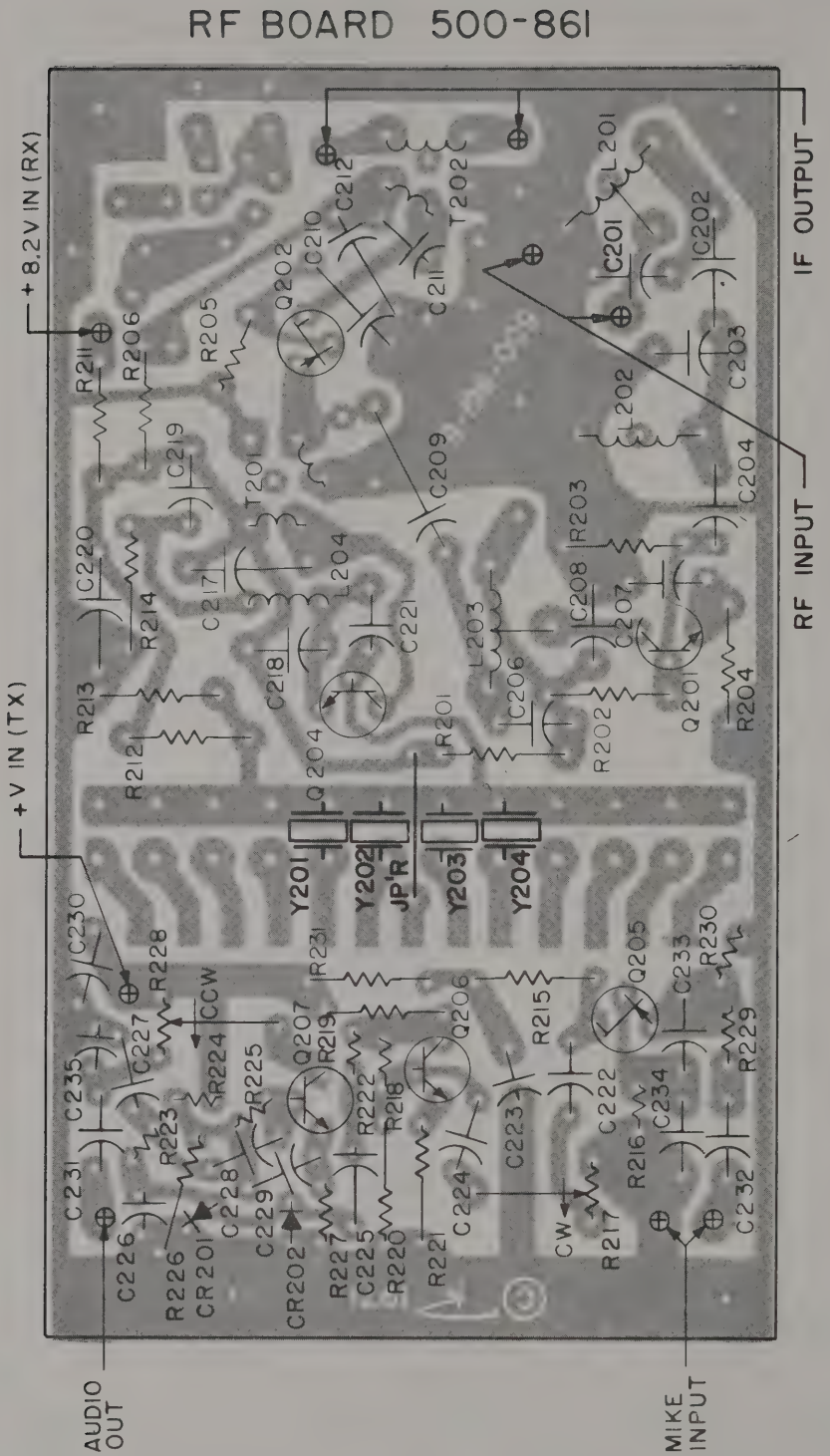
a. Connect the unit to the RF wattmeter or dummy load.
b. Connect the scope probe to the junction of C225 and CR201. See 4-1 for location. It may be more convenient to connect the probe to the cathode lead of CR202.
c. Key the transmitter and talk into the microphone with a normal voice level. Observe the waveform on the scope and adjust R217 (Mike Gain) until approximately 10% of the voice peaks are clipped.
d. Connect the audio generator to the mike input terminals. Set the audio voltage level to 0.5 - 1.0 volts RMS at 1000 Hz.
e. Couple the FM Modulation Meter's RF pick-up to the transmitter.
f. Key the transmitter and adjust R228 (Deviation Control) so that the maximum deviation is no greater than ±5 KHz.
g. Reduce the audio input level to 0.25 volts RMS. The deviation should not be greater than ±5 KHz.

SECTION 4 DIAGRAMS, VOLTAGE DATA AND SCHEMATICS

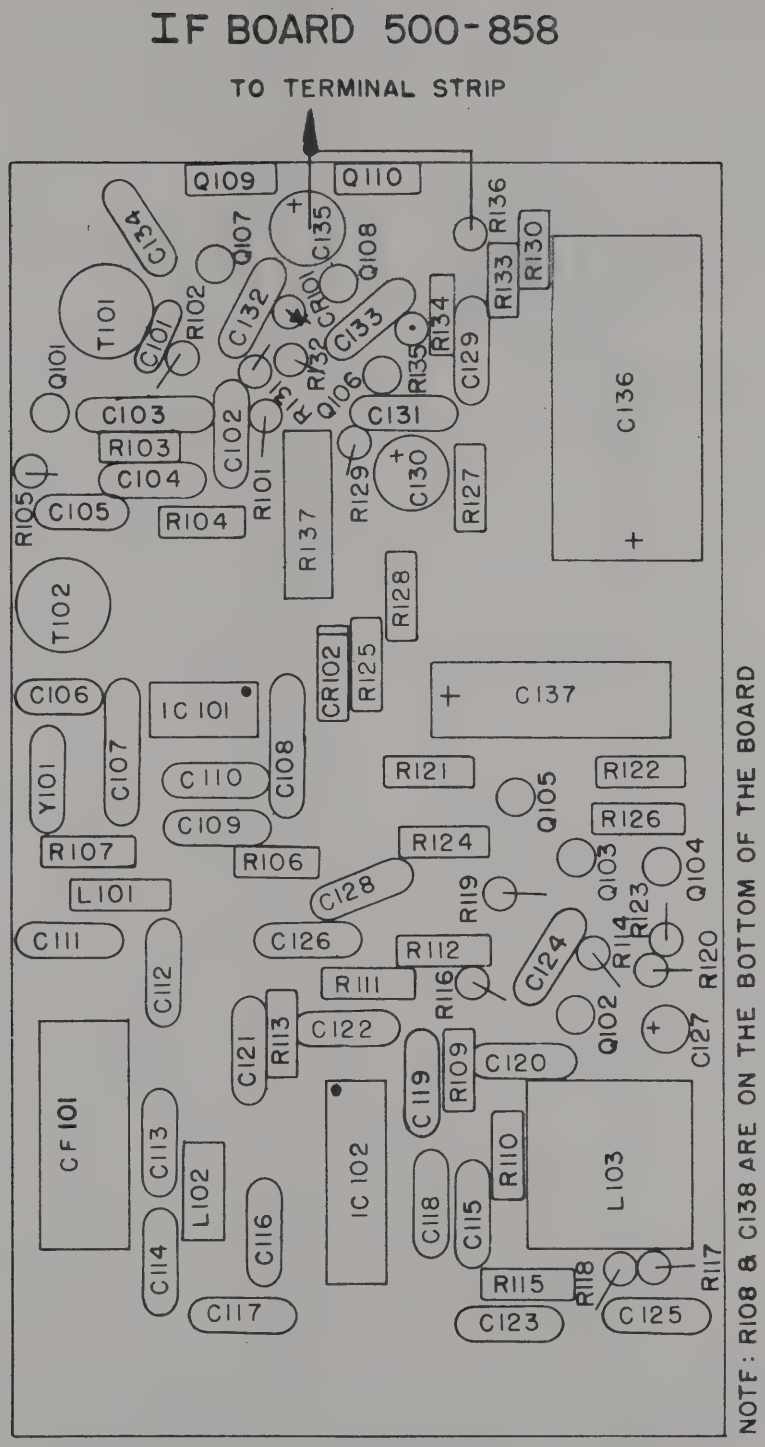
RF BOARD 500-861



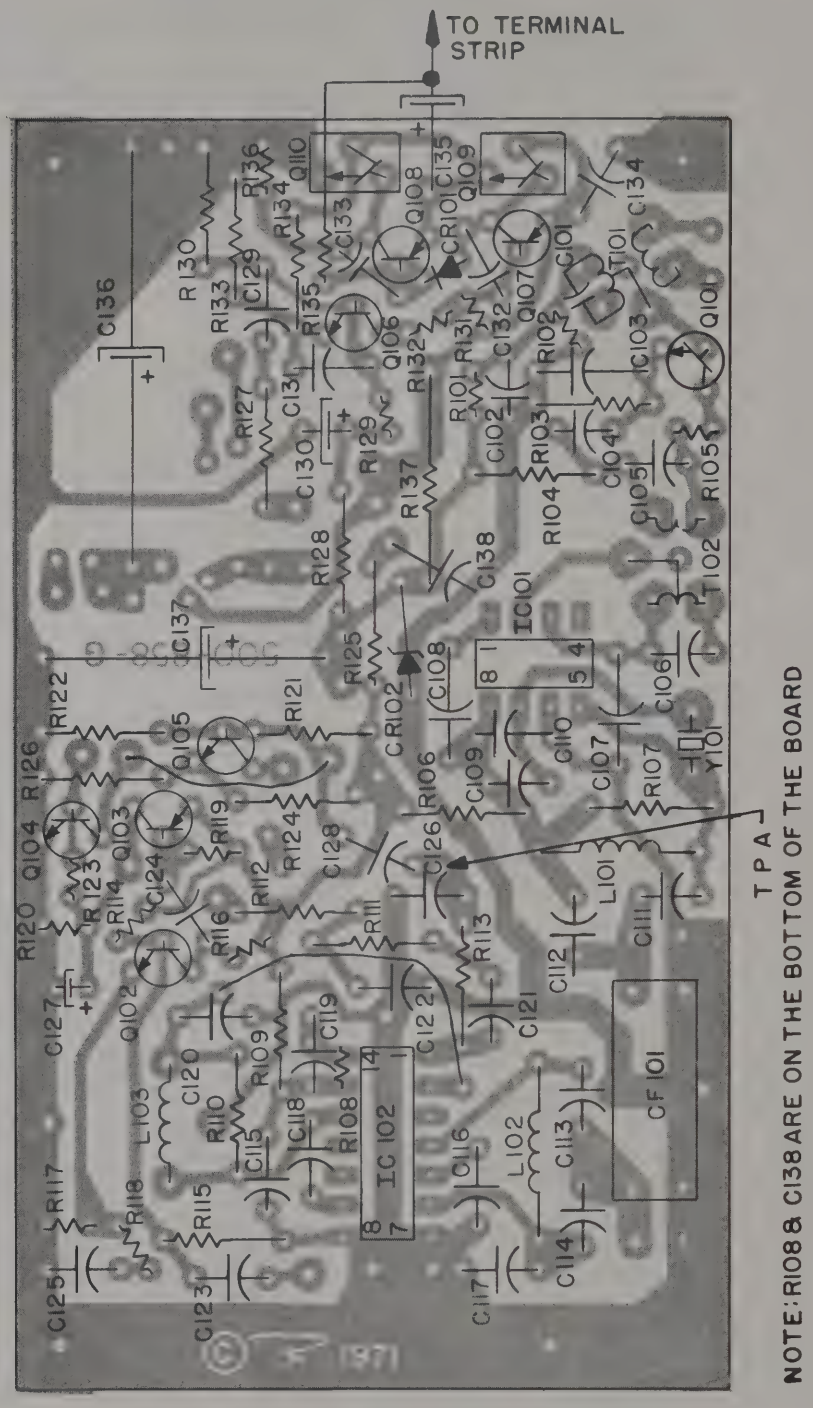
4-1 RF - MODULATOR BOARD PARTS PLACEMENT DIAGRAM



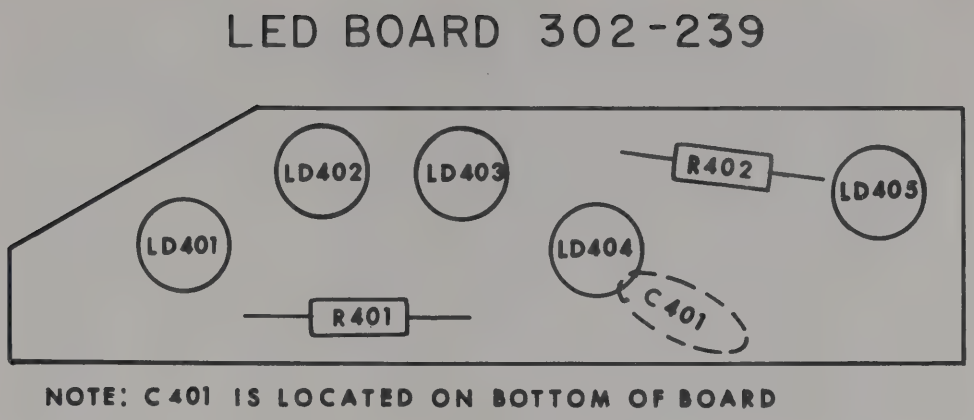
4-2 RF - MODULATOR BOARD BOTTOM VIEW



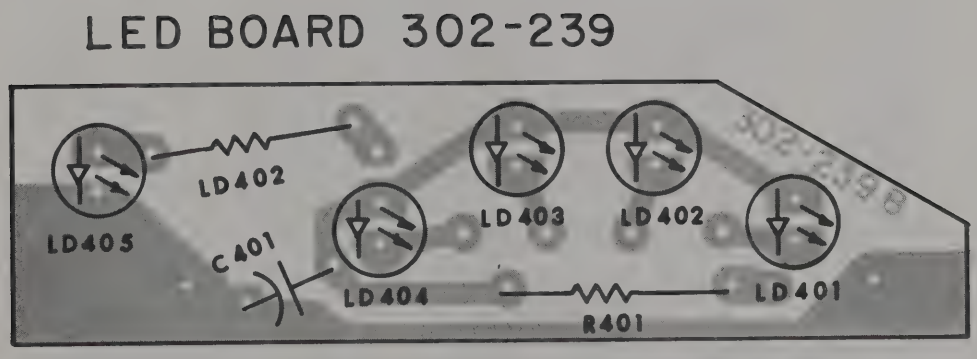
4-3 IF - AUDIO BOARD PARTS PLACEMENT DIAGRAM



4-4 IF - AUDIO BOARD BOTTOM VIEW

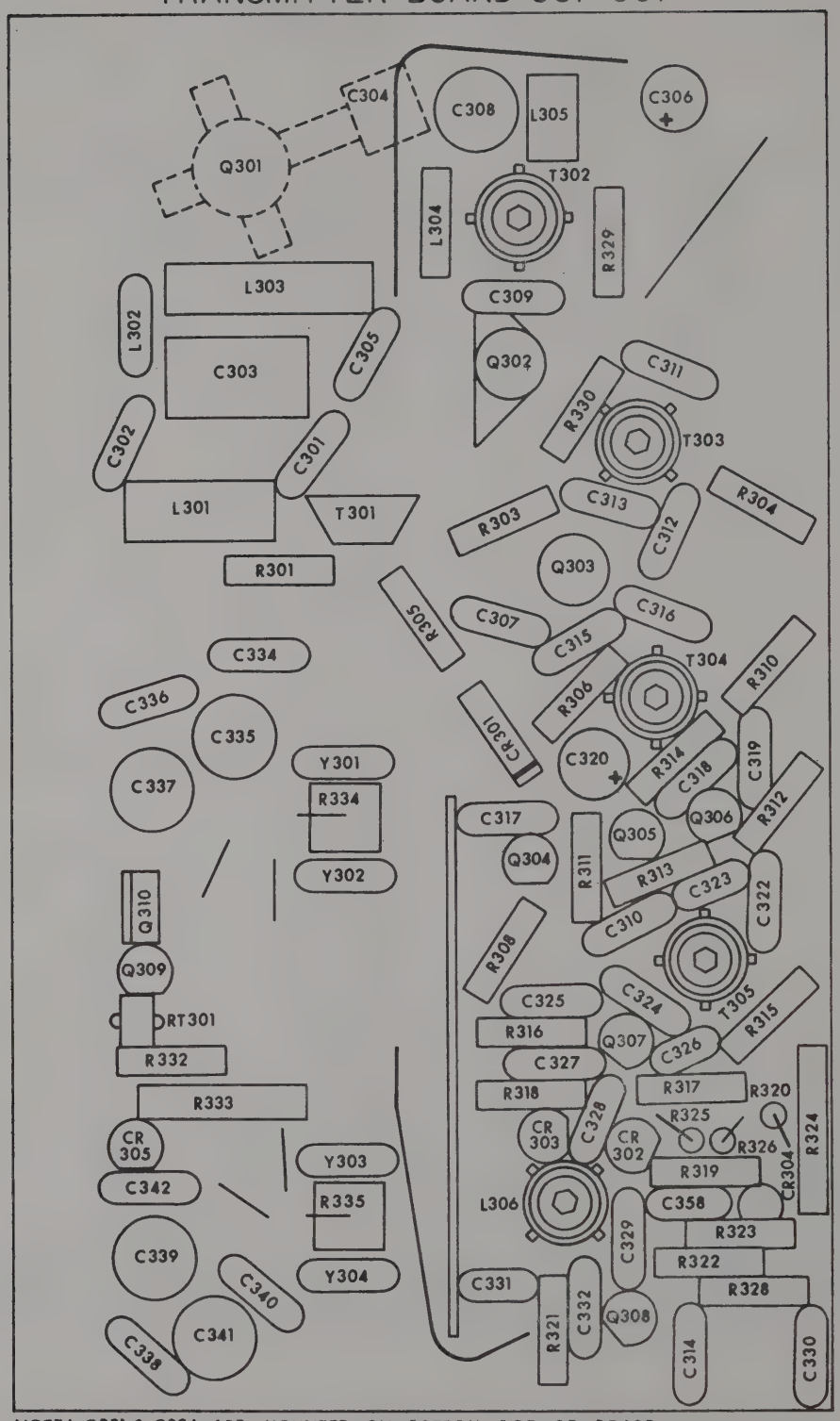


4-5 LED DISPLAY BOARD PARTS PLACEMENT DIAGRAM



4-6 LED DISPLAY BOARD BOTTOM VIEW

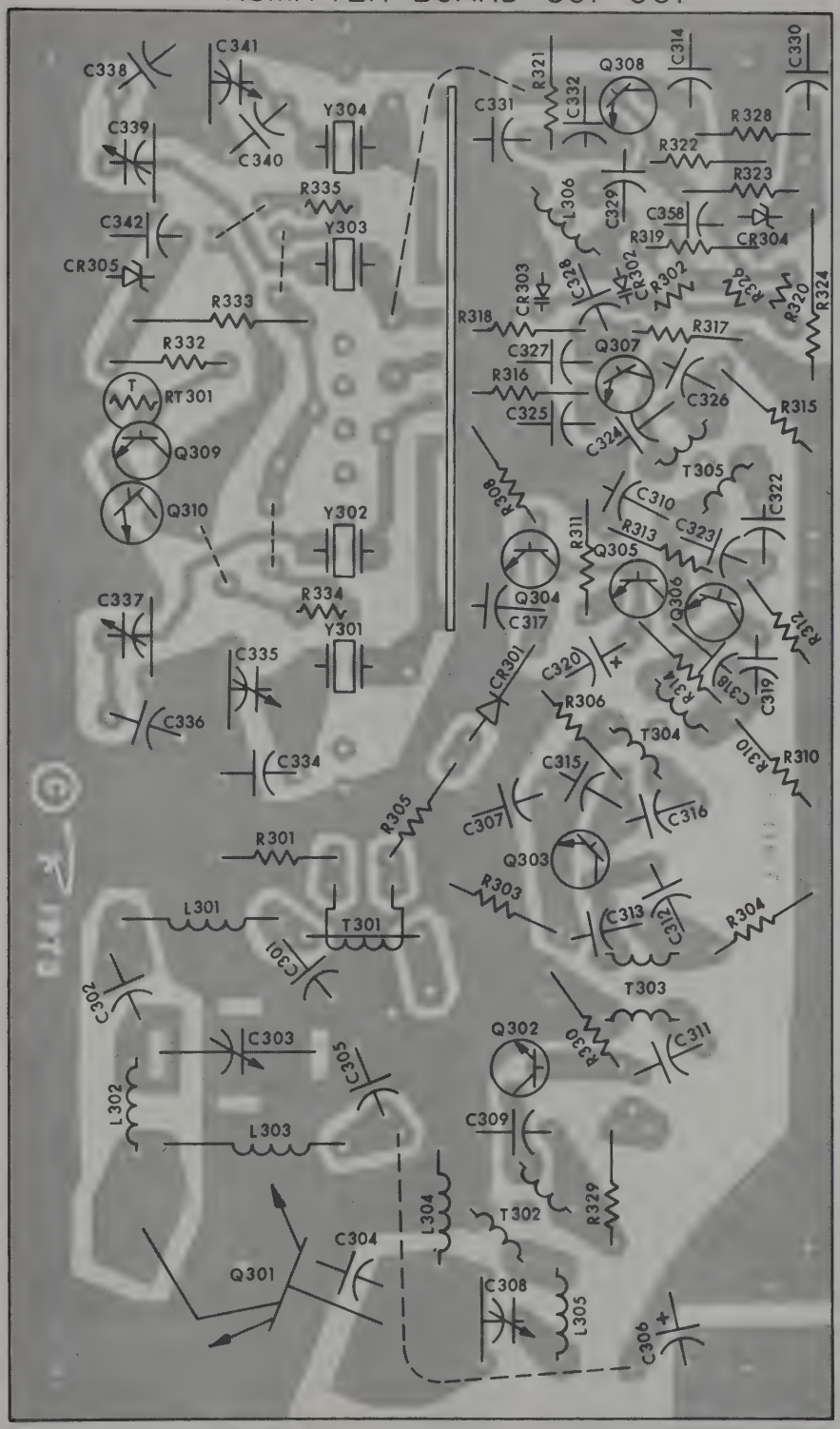
TRANSMITTER BOARD 501-067



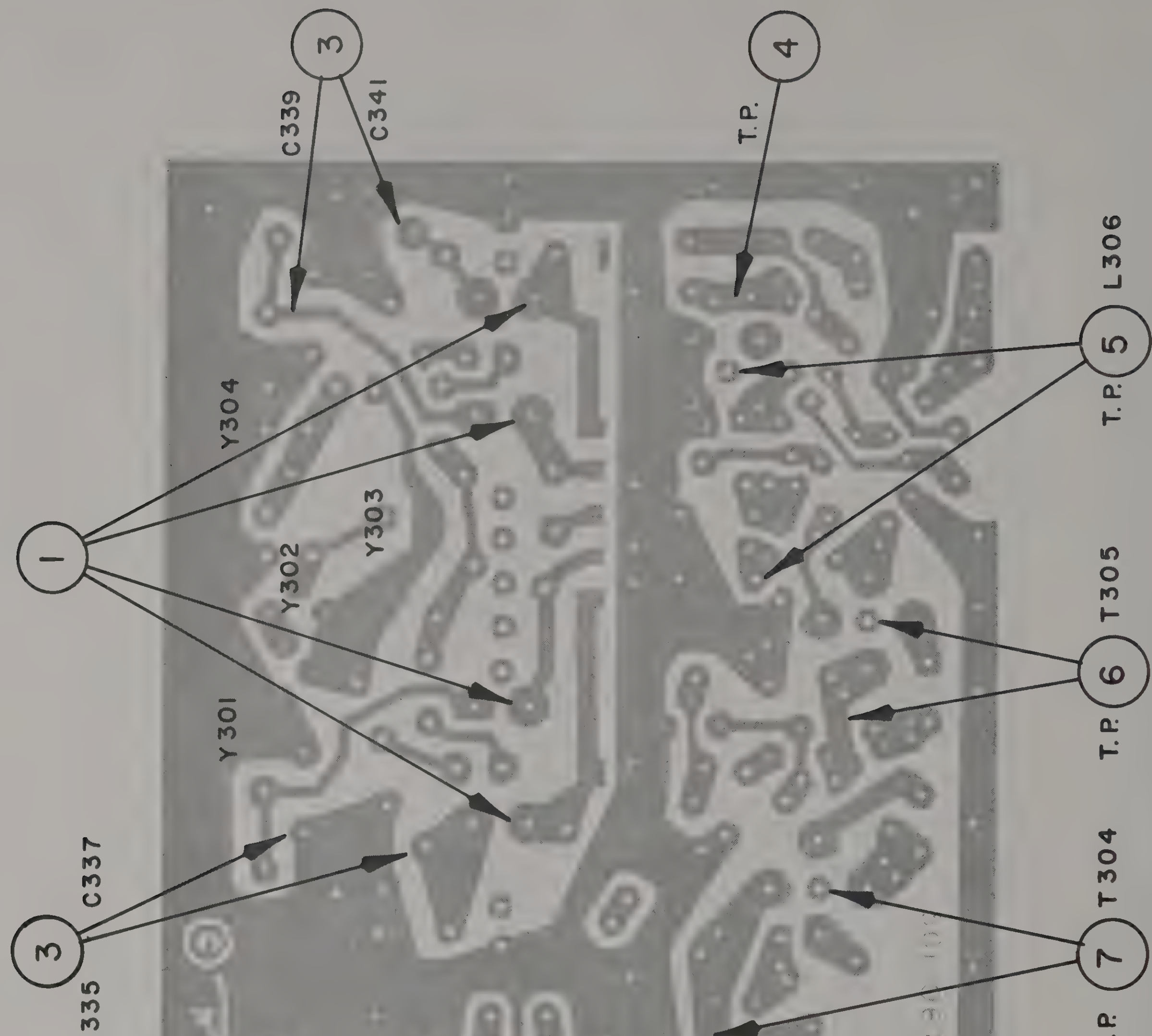
NOTE: Q301 & C304 ARE MOUNTED ON BOTTOM SIDE OF BOARD.

4-7 TRANSMITTER BOARD PARTS PLACEMENT DIAGRAM

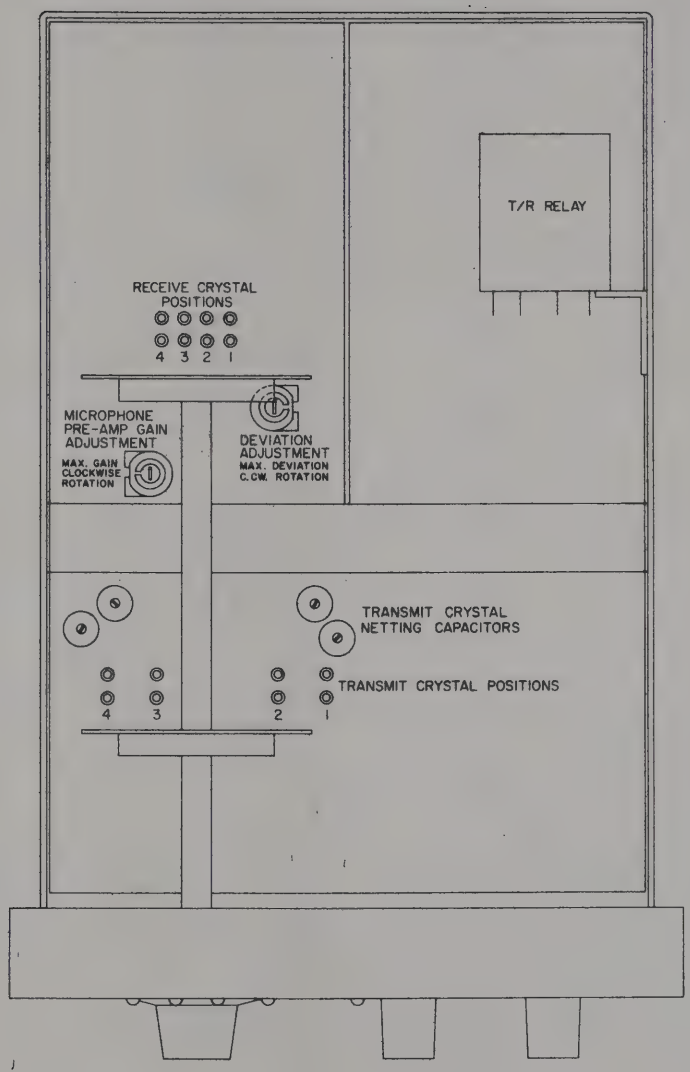
TRANSMITTER BOARD 501-067



4-8 TRANSMITTER BOARD BOTTOM VIEW



4-9 TRANSMITTER BOARD TUNE-UP TEST POINTS



4-10 CRYSTAL LOCATION AND ADJUSTMENT DIAGRAM

4-11 VOLTAGE DATA

NOTE: All voltages are nominal and are measured with a VTVM.
13.8 VDC Supply Voltage at input to cable supplied with unit.

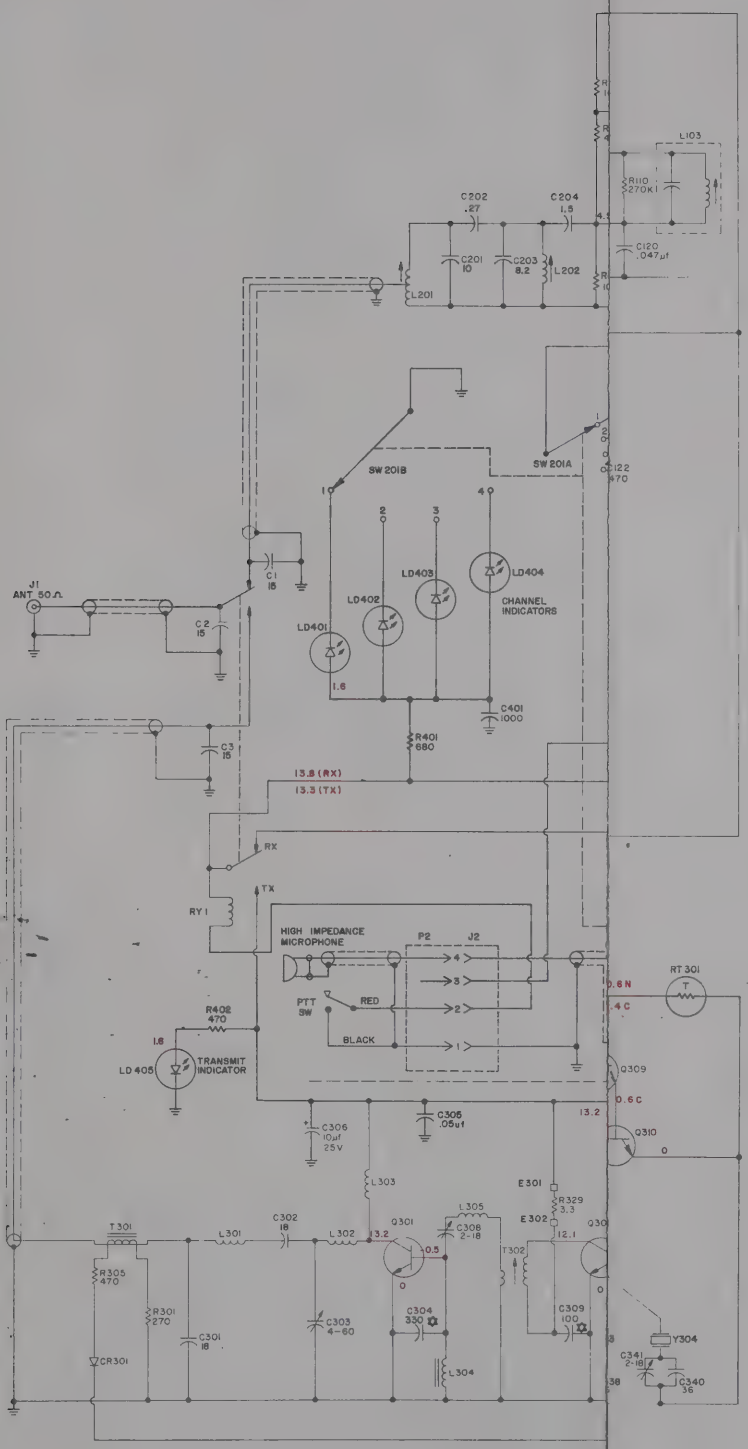
VOLTAGE DATA – TRANSISTORS

	Transistor	Emitter (Source)	Base (Gate)	Collector (Drain)
RF BOARD	Q201	3.8	4.5	6.9
No. 500-861	Q202 (FET)	1.0	0	6.2
	Q204	4.4	5.0	7.2
	Q205 (FET)	0.80	0	5.0
	Q206	0.20	0.80	4.6
	Q207	0.15-0.30	0.65-0.90	6.0 *(Varies with setting of R 2
IF BOARD				
No. 500-858	Q101	2.3	3.0	7.3
	Q102	1.0	1.7	4.8
	Q103 (PNP)	8.2	8.2	0 (Unsquelched)
		8.2	8.2	1.0 (Squelched)
		8.2	8.2	1.5 min. (tight squelch)
	Q104	0	0	1.9 (Unsquelched)
		0	0.80	0.30 (Squelched)
		0	0.80	1.10 (tight squelch)
	Q105	1.4	1.9	5.1 (Unsquelched)
		1.1	0.10	8.2 (tight squelch)
	Q106	0.7	1.3	12.4
	Q107 (PNP)	13.8	13.3	7.2
	Q108 (PNP)	6.9	6.6	0.10
	Q109	6.9	7.2	13.8
	Q110	0	0.10	6.9
TX BOARD	Q301	0	-0.5	13.2
No. 501-067	Q302	0	-0.4	12.1
	Q303	0.50	-0.2	12.4
	Q304	0	0.33	2.3
	Q305	1.4	2.3	1.6
	Q306	1.6	1.0	13.1
	Q307	1.9	1.4	12.2
	Q308	2.6	2.8	8.2
	Q309	–	0.6	13.8 (OFF - Ambient Temperature = 70° to 80°
		–	1.4	0.7 (ON - Ambient Temperatu less than 17°F)
	Q310	0	–	13.8 (OFF)
		0	–	0.7 (ON)

VOLTAGE DATA – INTERGRATED CIRCUITS

Note: Both IC's are located on the IF Board, 500-858.

IC No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC 101	4.2	0.7	0.7	4.2	7.8	0	4.2	7.8	–	–	–	–	–	–
IC 102	4.0	3.5	0	1.3	1.3	1.3	0	0	0.2	1.6	2.9	3.5	7.6	5.0



NOTES:

1. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD.
   ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS.
   ALL RESISTORS NOT SPECIFIED OTHERWISE ARE 1/4 WATT.
2. ✡ NOTED VALUES ARE FACTORY SELECTED. NOMINAL VALUES SHOWN.
3. —○— DENOTES A FERRITE BEAD PLACED ON THE COMPONENT LEAD.
4. R334 AND R335 ARE HEATING ELEMENTS FOR Y301, Y302, Y303 AND Y304
5. ALL VOLTAGES (FIGURES IN RED) ARE NOMINAL VALUES AS MEASURED WITH A VTVM AND SUPPLY VOLTAGE TO THE UNIT IS 13.8 VDC
   a. THE LETTER FOLLOWING THE VOLTAGE INDICATES THE FOLLOWING CONDITIONS:
      U = UNSQUELCHED
      S = SQUELCHED — THRESHOLD
      T = SQUELCHED — TIGHT
      N = HEATER TURNED OFF; NORMAL AMBIENT TEMPERATURE (70°–80°F)
      C = HEATER TURNED ON; COLD AMBIENT TEMPERATURE (LESS THAN 17°F)
   b. VOLTAGES INDICATED IN TRANSMITTER SECTION ARE MEASURED WITH THE TRANSMITTER OPERATING INTO A PROPER LOAD.

2 SCHEMATIC WITH VOLTAGES - BTH - 204

4-11 VOLTAGE DATA

NOTE: All voltages are nominal and are measured with a VTVM.
13.8 VDC Supply Voltage at input to cable supplied with unit.

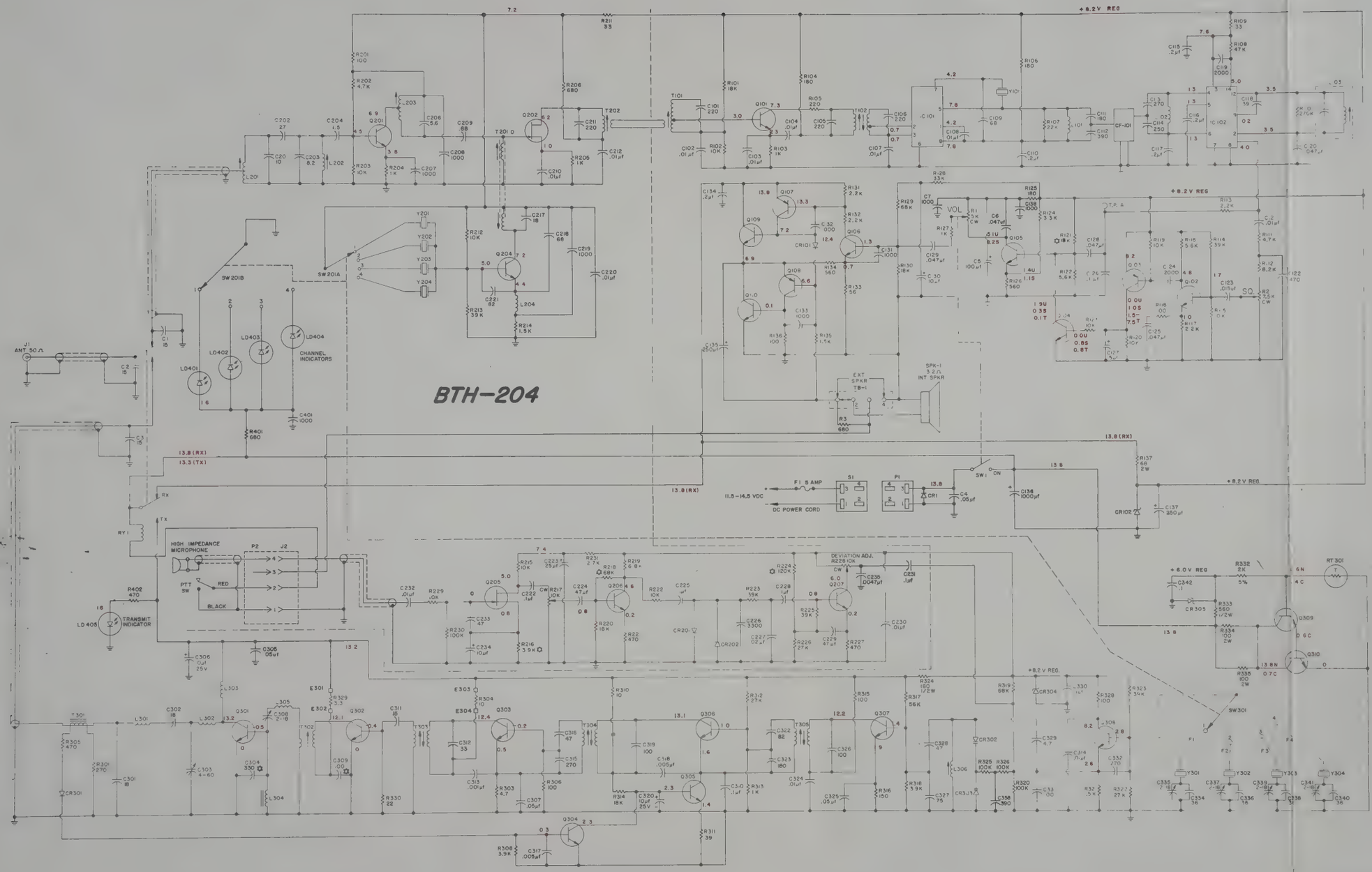
VOLTAGE DATA – TRANSISTORS

	Transistor	Emitter (Source)	Base (Gate)	Collector (Drain)
RF BOARD	Q201	3.8	4.5	6.9
No. 500-861	Q202 (FET)	1.0	0	6.2
	Q204	4.4	5.0	7.2
	Q205 (FET)	0.80	0	5.0
	Q206	0.20	0.80	4.6
	Q207	0.15-0.30	0.65-0.90	6.0 *(Varies with setting of R
IF BOARD				
No. 500-858	Q101	2.3	3.0	7.3
	Q102	1.0	1.7	4.8
	Q103 (PNP)	8.2	8.2	0 (Unsquelched)
		8.2	8.2	1.0 (Squelched)
		8.2	8.2	1.5 min. (tight squelch)
	Q104	0	0	1.9 (Unsquelched)
		0	0.80	0.30 (Squelched)
		0	0.80	1.10 (tight squelch)
	Q105	1.4	1.9	5.1 (Unsquelched)
		1.1	0.10	8.2 (tight squelch)
	Q106	0.7	1.3	12.4
	Q107 (PNP)	13.8	13.3	7.2
	Q108 (PNP)	6.9	6.6	0.10
	Q109	6.9	7.2	13.8
	Q110	0	0.10	6.9
TX BOARD	Q301	0	-0.5	13.2
No. 501-067	Q302	0	-0.4	12.1
	Q303	0.50	-0.2	12.4
	Q304	0	0.33	2.3
	Q305	1.4	2.3	1.6
	Q306	1.6	1.0	13.1
	Q307	1.9	1.4	12.2
	Q308	2.6	2.8	8.2
	Q309	–	0.6	13.8 (OFF - Ambient Temperature = 70° to 80°
		–	1.4	0.7 (ON - Ambient Temperatu less than 17°F)
	Q310	0	–	13.8 (OFF)
		0	–	0.7 (ON)

VOLTAGE DATA – INTERGRATED CIRCUITS

Note: Both IC's are located on the IF Board, 500-858.

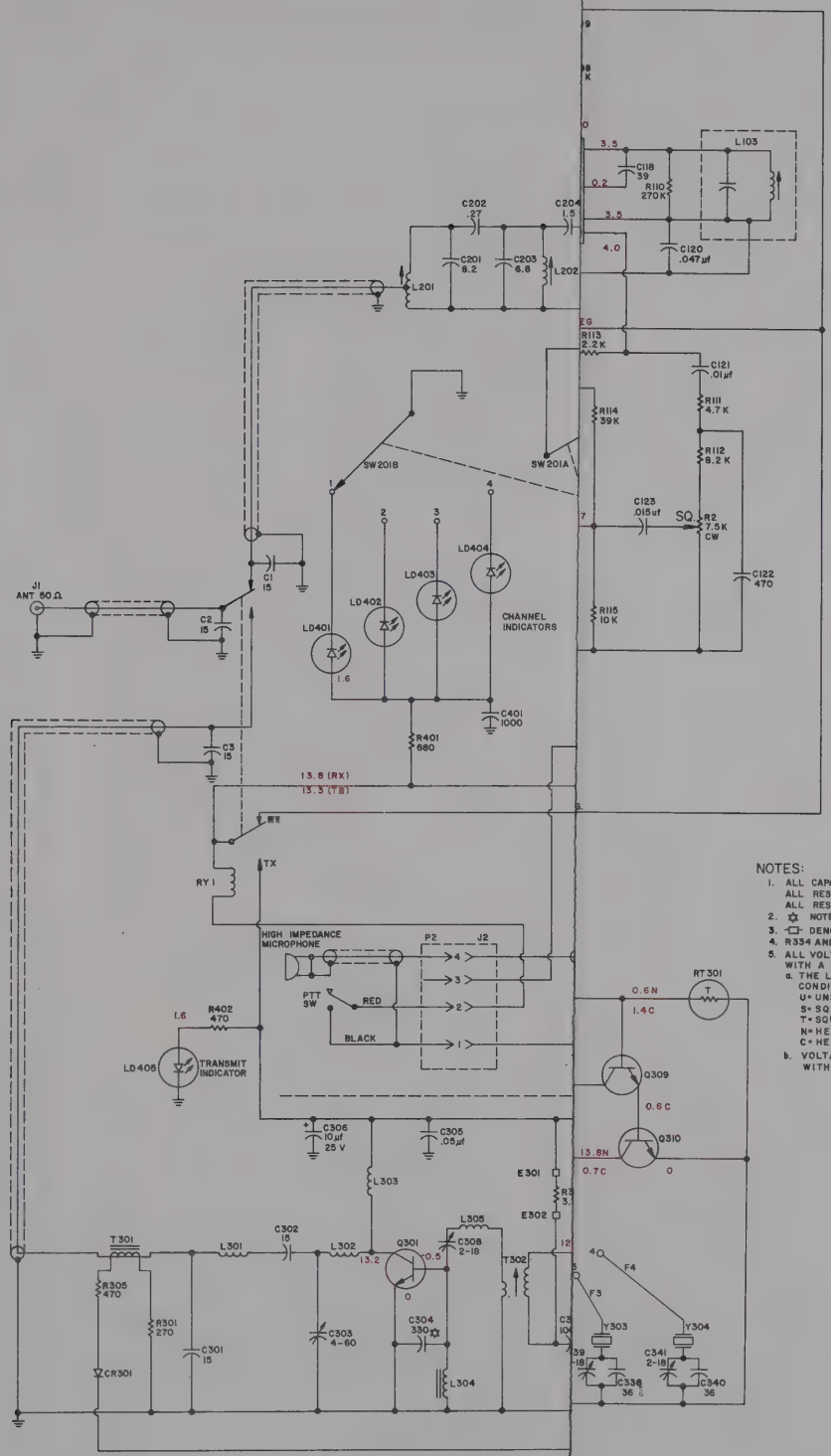
IC No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC 101	4.2	0.7	0.7	4.2	7.8	0	4.2	7.8	–	–	–	–	–	–
IC 102	4.0	3.5	0	1.3	1.3	1.3	0	0	0.2	1.6	2.9	3.5	7.6	5.0



4-12 SCHEMATIC WITH VOLTAGES - BTH - 204

NOTES:

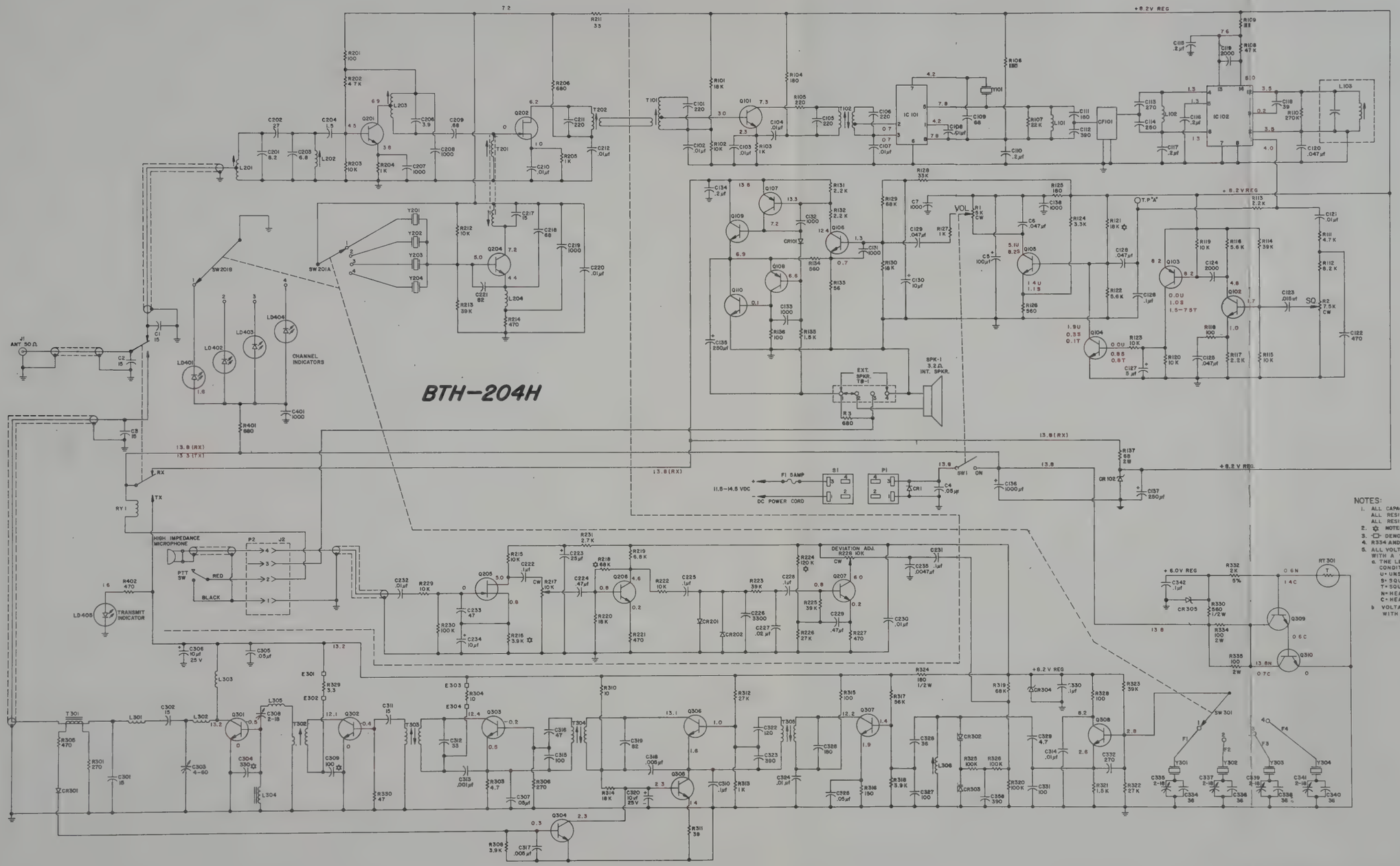
1. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD
   ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS.
   ALL RESISTORS NOT SPECIFIED OTHERWISE ARE 1/4 WATT.
2. ✡ NOTED VALUES ARE FACTORY SELECTED. NOMINAL VALUES SHOWN.
3. —○— DENOTES A FERRITE BEAD PLACED ON THE COMPONENT LEAD.
4. R334 AND R335 ARE HEATING ELEMENTS FOR Y301, Y302, Y303 AND Y304
5. ALL VOLTAGES (FIGURES IN RED) ARE NOMINAL VALUES AS MEASURED WITH A VTVM AND SUPPLY VOLTAGE TO THE UNIT IS 13.8 VDC
   a. THE LETTER FOLLOWING THE VOLTAGE INDICATES THE FOLLOWING CONDITIONS:
      U=UNSQUELCHED
      S=SQUELCHED — THRESHOLD
      T=SQUELCHED — TIGHT
      N=HEATER TURNED OFF; NORMAL AMBIENT TEMPERATURE (70°-80°F)
      C=HEATER TURNED ON, COLD AMBIENT TEMPERATURE (LESS THAN 17°F)
   b. VOLTAGES INDICATED IN TRANSMITTER SECTION ARE MEASURED WITH THE TRANSMITTER OPERATING INTO A PROPER LOAD.



NOTES:

1. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD.
   ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS.
   ALL RESISTORS NOT SPECIFIED OTHERWISE ARE 1/4 WATT.
2. ✡ NOTED VALUES ARE FACTORY SELECTED. NOMINAL VALUES SHOWN.
3. -□- DENOTES A FERRITE BEAD PLACED ON THE COMPONENT LEAD.
4. R334 AND R335 ARE HEATING ELEMENTS FOR Y301, Y302, Y303 AND Y304.
5. ALL VOLTAGES (FIGURES IN RED) ARE NOMINAL VALUES AS MEASURED WITH A VTVM AND SUPPLY VOLTAGE TO THE UNIT IS 13.8 VDC.
   a. THE LETTER FOLLOWING THE VOLTAGE INDICATES THE FOLLOWING CONDITIONS:
      U = UNSQUELCHED
      S = SQUELCHED – THRESHOLD
      T = SQUELCHED – TIGHT
      N = HEATER TURNED OFF; NORMAL AMBIENT TEMPERATURE (70°–80°F)
      C = HEATER TURNED ON; COLD AMBIENT TEMPERATURE (LESS THAN 17°F)
   b. VOLTAGES INDICATED IN TRANSMITTER SECTION ARE MEASURED WITH THE TRANSMITTER OPERATING INTO A PROPER LOAD.

13 SCHEMATIC WITH VOLTAGES - BTH - 204H



4-13 SCHEMATIC WITH VOLTAGES - BTH - 204H

SECTION 5 PARTS LIST

NOTE: Parts with an asterisk (*) denotes those values that are used only in the BTH-204H. All other listed parts are common to both units.

When ordering parts, please include the following information:

a. Model Number (BTH-204 or BTH-204H)
b. Item Number
c. Description
d. Part Number

5-1 RF - MODULATOR BOARD 500-861

Item	Description	Part No.
	RESISTORS	
R201	100 ohm, 10%, ¼W	4701-0101-042
R202	4.7K, 10%, ¼W	4701-0472-042
R203	10K, 10%, ¼W	4701-0103-042
R204	1K, 10%, ¼W	4701-0102-042
R205	1K, 10%, ¼W	4701-0102-042
R206	680 ohm, 10%, ¼W	4701-0681-042
R211	33 ohm, 10%, ¼W	4701-0330-042
R212	10K, 10%, ¼W	4701-0103-042
R213	39K, 10%, ¼W	4701-0393-042
R214	1.5K, 10%, ¼W	4701-0152-042
*R214	470 ohm, 10%, ¼W	4701-0471-042
R215	10K, 10%, ¼W	4701-0103-042
R216	3.9K, 10%, ¼W	4701-0392-042
R217	10K, Trimmer	4751-0103-001
R218	68K, 10%, ¼W	4701-0683-042
R219	6.8K, 10%, ¼W	4701-0682-042
R220	18K, 10%, ¼W	4701-0183-042
R221	470 ohm, 10%, ¼W	4701-0471-042
R222	10K, 10%, ¼W	4701-0103-042
R223	39K, 10%, ¼W	4701-0393-042
R224	120K, 10%, ¼W	4701-0124-042
R225	39K, 10%, ¼W	4701-0393-042
R226	27K, 10%, ¼W	4701-0273-042
R227	470 ohm, 10%, ¼W	4701-0471-042
R228	10K, Trimmer	4751-0103-001
R229	10K, 10%, ¼W	4701-0103-042
R230	100K, 10%, ¼W	4701-0104-042
R231	2.7K, 10%, ¼W	4701-0272-042
	CAPACITORS	
C201	10PF, 10%, NPO, 500V (DISC)	1500-0100-905
*C201	8.2PF, 10%, NPO, 500V (DISC)	1500-0829-905
C202	.27PF, 10%, (COMPOSITION)	1510-0278-900
C203	8.2PF, 10%, NPO, 500V (DISC)	1500-0829-905
*C203	6.8PF, 10%, NPO, 500V (DISC)	1500-0689-905
C204	1.5PF, ± .25PF, NPO, 500V (DISC)	1500-0159-205
C206	5.6PF, 10%, NPO, 500V (DISC)	1500-0569-905
*C206	3.9PF, 10%, NPO, 500V (DISC)	1500-0399-905
C207	.001 mfd, +80 - 20%, 500V (DISC)	1503-0102-001
C208	.001 mfd, +80 - 20%, 500V (DISC)	1503-0102-001
C209	.68PF, 10% (COMPOSITION)	1510-0688-900
C210	.01 mfd, +80 - 20%, 500V (DISC)	1503-0103-001
C211	220PF, 5%, 50V (MICA)	1506-0221-550
C212	.01 mfd, +80 - 20%, 500V (DISC)	1503-0103-001
C217	18PF, 10%, NPO, 500V (DISC)	1501-0180-001
*C217	15PF, 10%, NPO, 500V (DISC)	1501-0150-001
C218	68PF, 5%, 50V (MICA)	1506-0680-550
C219	.001 mfd, +80 - 20%, 500V (DISC)	1503-0102-001
C220	.01 mfd, +80 - 20%, 500V (DISC)	1503-0103-001
C221	82PF, 5%, 50V (MICA)	1506-0820-550
C222	.1 mfd, 20%, 12V (DISC)	1502-0104-005
C223	25 mfd, 10V, 85°C (ELECTROLYTIC)	1513-0250-001
C224	.47 mfd, +80 - 20%, 3V (DISC)	1502-0474-001
C225	.1 mfd, 20%, 12V (DISC)	1502-0104-005
C226	.0033 mfd, 10%, 100V (MYLAR FILM)	1508-0332-610
C227	.022 mfd, 10%, 100V (MYLAR FILM)	1508-0223-610
C228	.1 mfd, 20%, 12V (DISC)	1502-0104-005
C229	.47 mfd, +80 - 20%, 3V (DISC)	1502-0474-001
C230	.01 mfd, 10%, 100V (MYLAR FILM)	1508-0103-610
C231	.1 mfd, 20%, 12V (DISC)	1502-0104-005
C232	.01 mfd, 10%, 100V (MYLAR FILM)	1508-0103-610
C233	47PF, 5%, 50V (MICA)	1506-0470-550
C234	10 mfd, 10V, 85°C (ELECTROLYTIC)	1513-0100-001
C235	.0047 mfd, 10%, 100V (MYLAR FILM)	1508-0472-610
	COILS	
L201	Antenna Input (Brown)	1800-3152-001
L202	RF Input (Red)	1800-3152-002
L203	RF Output (Black)	1800-3152-008
L204	Oscillator, emitter	1801-1236-900
T201	Oscillator, output	1800-3170-100
T202	Mixer, output	1800-3170-200
	DIODES	
CR201	Silicon, Signal	4805-1241-200
CR202	Silicon, Signal	4805-1241-200
	TRANSISTORS	
Q201	Silicon, NPN (Red Top)	4801-0000-035
Q202	Field Effect, Junction	4811-0000-030
Q204	Silicon, NPN	4801-0000-095
Q205	Field Effect, Junction	4811-0000-030
Q206	Silicon, NPN	4801-0000-010
Q207	Silicon, NPN	4801-0000-010

*Indicates values used in BTH-204H

5-2 IF - AUDIO BOARD 500-858

Item	Description	Part No.
	RESISTORS	
R101	18K, 10%, ¼W	4701-0183-042
R102	10K, 10%, ¼W	4701-0103-042
R103	1K, 10%, ¼W	4701-0102-042
R104	180 ohm, 10%, ¼W	4701-0181-042
R105	220 ohm, 10%, ¼W	4701-0221-042
R106	180 ohm, 10%, ¼W	4701-0181-042
R107	22K, 10%, ¼W	4701-0223-042
R108	47K, 10%, ¼W	4701-0473-042
R109	33 ohm, 10% ¼W	4701-0330-042
R110	270K, 10%, ¼W	4701-0274-042
R111	4.7K, 10%, ¼W	4701-0472-042
R112	8.2K, 10%, ¼W	4701-0822-042
R113	2.2K, 10%, ¼W	4701-0222-042
R114	39K, 10%, ¼W	4701-0393-042
R115	10K, 10%, ¼W	4701-0103-042
R116	5.6K, 10%, ¼W	4701-0562-042
R117	2.2K, 10%, ¼W	4701-0222-042
R118	100 ohm, 10%, ¼W	4701-0101-042
R119	10K, 10%, ¼W	4701-0103-042
R120	10K, 10%, ¼W	4701-0103-042
R121	18K, 10%, ¼W	4701-0183-042
R122	5.6K, 10%, ¼W	4701-0562-042
R123	10K, 10%, ¼W	4701-0103-042
R124	3.3K, 10%, ¼W	4701-0332-042
R125	180 ohm, 10%, ¼W	4701-0181-042
R126	560 ohm, 10%, ¼W	4701-0561-042
R127	1K, 10%, ¼W	4701-0102-042
R128	33K, 10%, ¼W	4701-0333-042
R129	68K, 10%, ¼W	4701-0683-042
R130	18K, 10%, ¼W	4701-0183-042
R131	2.2K, 10%, ¼W	4701-0222-042
R132	2.2K, 10%, ¼W	4701-0222-042
R133	56 ohm, 10%, ¼W	4701-0560-042
R134	560 ohm, 10%, ¼W	4701-0561-042
R135	1.5K, 10%, ¼W	4701-0152-042
R136	100 ohm, 10%, ¼W	4701-0101-042
R137	68 ohm, 10%, 2W (wire wound)	4710-0680-041
	CAPACITORS	
C101	220PF, 5%, 50V (MICA)	1506-0221-550
C102	.01 mfd, 10%, 100V (Mylar Film)	1508-0103-610
C103	.01 mfd, +80 - 20%, 500V (DISC)	1503-0103-001
C104	.01 mfd, 10%, 100V (Mylar Film)	1508-0103-610
C105	220PF, 5%, 50V (MICA)	1506-0221-550
C106	220PF, 5%, 50V (MICA)	1506-0221-550
C107	.01 mfd, +80 - 20%, 500V (DISC)	1503-0103-001
C108	.01 mfd, +80 - 20%, 500V (DISC)	1503-0103-001
C109	68PF, 5%, 50V (MICA)	1506-0680-550
C110	.2 mfd, +80 - 20%, 12V (DISC)	1502-0204-006
C111	180PF, 5%, 50V (MICA)	1506-0181-550
C112	390PF, 5%, 50V (MICA)	1506-0391-550
C113	270PF, 5%, 50V MICA	1506-0271-550
C114	250PF, 5%, 50V (MICA)	1506-0251-550
C115	.2 mfd, +80 - 20%, 12V (DISC)	1502-0204-006
C116	.2 mfd, +80 - 20%, 12V (DISC)	1502-0204-006
C117	.2 mfd, +80 - 20%, 12V (DISC)	1502-0204-006
C118	39PF, 10%, NPO, 500V (DISC)	1500-0390-605
C119	.002 mfd, 20%, 500V (DISC)	1523-0202-001
C120	.047 mfd, 10%, 100V (Mylar Film)	1508-0473-610
C121	.01 mfd, 10%, 100V (Mylar Film)	1508-0103-610
C122	470PF, 20%, 500V (DISC)	1523-0471-001
C123	.015 mfd, 10%, 100V (Mylar Film)	1508-0153-610
C124	.002 mfd, 20%, 500V (DISC)	1523-0202-001
C125	.047 mfd, 10%, 100V (Mylar Film)	1508-0473-610
C126	.1 mfd, 20%, 12V (DISC)	1502-0104-005

Item	Description	Part No.
C127	5 mfd, 50V, 85°C (Electrolytic)	1513-0050-004
C128	.047 mfd, 10%, 100V (Mylar Film)	1500-0473-610
C129	.047 mfd, 10%, 100V (Mylar Film)	1508-0473-610
C130	10 mfd, 25V, 85°C (Electrolytic)	1513-0100-003
C131	.001 mfd, +80 - 20%, 500V (DISC)	1503-0102-001
C132	.001 mfd, +80 - 20%, 500V (DISC)	1503-0102-001
C133	.001 mfd, +80 - 20%, 500V (DISC)	1503-0102-001
C134	.2 mfd, +80 - 20%, 12V (DISC)	1502-0204-006
C135	250 mfd, 16V, 85°C (Electrolytic)	1511-0251-002
C136	1000 mfd, 16V, 85°C (Electrolytic)	1511-0102-002
C137	250 mfd, 10V, 85°C (Electrolytic)	1511-0251-001
C138	.001 mfd, +80 - 20%, 50V (DISC)	1503-0000-008
	COILS	
L101	Choke, 820 mhy, shielded	1803-3182-700
L102	Choke, 820 mhy, shielded	1803-3182-700
L103	Quadrature Detector	1800-3151-700
T101	Input, 10.7 mHz IF AMP	1800-1250-700
T102	Output, 10.7 mHz IF AMP	1800-3168-300
	DIODES	
CR101	Silicon, Signal	4805-1241-200
CR102	Zener, 8.2V 5%, 1W	4808-0000-009
	TRANSISTORS	
Q101	Silicon, NPN	4801-0000-010
Q102	Silicon, NPN	4801-0000-010
Q103	Silicon, PNP (White Top)	4801-0000-060
Q104	Silicon, NPN	4801-0000-010
Q105	Silicon, NPN	4801-0000-010
Q106	Silicon, NPN	4801-0000-010
Q107	Silicon, PNP, AF Driver	4801-0000-135
Q108	Silicon, PNP, AF Driver	4801-0000-135
Q109	Silicon, NPN, AF Output	4802-0000-002
Q110	Silicon, NPN, AF Output	4802-0000-002
	INTEGRATED CIRCUITS	
IC101	IF Amplifier	3130-3167-901
IC102	IF Limiter/Detector	3130-3157-603
	CRYSTAL	
Y101	10.245 mHz (Standard)	2301-3151-601
Y101	11.155 mHz (Special)	2301-3151-602
	FILTER	
CF101	Ceramic, 455 KHz	2700-0000-008

5-3 LED BOARD 302-239

Item	Description	Part No.
	RESISTORS	
R401	470 ohm, 10%, 1/3 W	4704-0471-042
R402	680 ohm, 10%, 1/3 W	4704-0681-042
	CAPACITORS	
C401	.001 mfd, +80 - 20%, 50V (DISC)	1503-0102-003
	DIODES	
LD401	LED, Red	4810-1282-900
LD402	LED, Red	4810-1282-900
LD403	LED, Red	4810-1282-900
LD404	LED, Red	4810-1282-900
LD405	LED, Red	4810-1282-900

5-4 TRANSMITTER BOARD 501-067

Item	Description	Part No.
	RESISTORS	
R301	270 ohm, 10%, ¼W	4701-0271-042
R303	4.7 ohm, 10%, ¼W	4701-0479-042
R304	10 ohm, 10%, ¼W	4701-0100-042
R305	470 ohm, 10%, ¼W	4701-0471-042
R306	100 ohm, 10%, ¼W	4701-0101-042
R308	3.9K, 10%, ¼W	4701-0392-042
R310	10 ohm, 10%, ¼W	4701-0100-042
R311	39 ohm, 10%, ¼W	4701-0390-042
R312	27K, 10%, ¼W	4701-0273-042
R313	1K, 10%, ¼W	4701-0102-042
R314	18K, 10%, ¼W	4701-0183-042
R315	100 ohm, 10%, ¼W	4701-0101-042
R316	150 ohm, 10%, ¼W	4701-0151-042
R317	56K, 10%, ¼W	4701-0563-042
R318	3.9K, 10%, ¼W	4701-0392-042
R319	68K, 10%, ¼W	4701-0683-042
R320	100K, 10%, ¼W	4701-0104-042
R321	1.5K, 10%, ¼W	4701-0152-042
R322	27K, 10%, ¼W	4701-0273-042
R323	39K, 10%, ¼W	4701-0271-042
R324	180 ohm, 10%, ½W	4701-0181-044
R325	100K, 10%, ¼W	4701-0104-042
R326	100K, 10%, ¼W	4701-0104-042
R328	100 ohm, 10%, ¼W	4701-0101-042
R329	3.3 ohm, 5%, ¼W	4701-0339-042
R330	22 ohm, 10%, ¼W	4701-0220-042
*R330	47 ohm, 10%, ¼W	4701-0470-042
R332	2K, 5%, ¼W	4701-0202-032
R333	560 ohm, 10%, ½W	4701-0561-044
R334	100 ohm, 5%, 2W (wire wound)	4701-0101-031
R335	100 ohm, 5%, 2W (wire wound)	4701-0101-031
RT301	Thermistor	5300-0000-001
	CAPACITORS	
C301	18PF, 10%, NPO, 50V (DISC)	1500-0180-650
*C301	15PF, 10%, NPO, 50V (DISC)	1500-0150-650
C302	18PF, 10%, NPO, 50V DISC	1500-0180-650
*C302	15PF, 10%, NPO, 50V (DISC)	1500-0150-650
C303	4-60PF, Trimmer	1517-0000-002
C304	330PF, 350V, (MICA)	1522-0331-001
C305	.05 mfd, +80 - 20%, 25V (DISC)	1502-0503-004
C306	10 mfd, 20%, 25V (TANT)	1515-0100-005
C307	.05 mfd, +80 - 20%, 12V (DISC)	1502--0503-006
C308	2-18PF, Trimmer	1517-0000-001
C309	100PF, 5%, 50V (MICA)	1506-0101-550
C310	.1 mfd, 20%, 12V (DISC)	1502-0104-005
C311-	15PF, 10%, NPO, 500V (DISC)	1500-0150-605
C312	33PF, 10%, NPO, 50V (DISC)	1500-6330-650
C313	.001 mfd, +80 - 20%, 50V (DISC)	1503-0102-003
C314	.01 mfd, +80 - 20%, 25V (DISC)	1502-0103-004
C315	270PF, 5%, 50V (MICA)	1506-0271-550
*C315	100PF, 5%, 50V (MICA)	1506-0101-550
C316	47PF, 5%, NPO, 50V (DISC)	1524-0470-002
C317	.005 mfd, +80 - 20%, 50V (DISC)	1503-0502-005
C318	.005 mfd, +80 - 20%, 50V (DISC)	1503-0502-005
C319	100PF, 5%, 50V (MICA)	1506-0101-550
*C319	82PF, 5%, 50V (MICA)	1506-0820-550
C320	10 mfd, 20%, 25V (TANT)	1515-0100-005
C322	82PF, 5%, 50V (MICA)	1506-0820-550
*C322	120PF, 5%, 50V (MICA)	1506-0121-550
C323	180PF, 5% 50V (MICA)	1506-0181-550
*C323	390PF, 5%, 50V (MICA)	1506-0391-550
C324	.01 mfd, +80 - 20%, 25V (DISC)	1502-0103-004
C325	.05 mfd, +80 - 20%, 12V (DISC)	1502-0503-006

Item	Description	Part No.
C326	100PF, 5%, 50V (MICA)	1506-0101-550
*C326	180PF, 5%, 50V (MICA)	1506-0181-550
C327	75PF, 5%, NPO, 50V (DISC)	1524-0750-002
*C327	100PF, 5%, 50V (MICA)	1506-0101-550
C328	47PF, 5%, NPO, 50V (DISC)	1524-0470-002
*C328	36PF, 5%, NPO, 50V (DISC)	1524-0360-001
C329	4.7PF, 10%, NPO, 500V (DISC)	1500-0479-905
C330	.1 mfd, 20%, 12V (DISC)	1502-0104-005
C331	100PF, 5%, 500V (MICA)	1504-0101-505
C332	270PF, 5%, 50V (MICA)	1506-0271-550
C334	36PF, 5%, NPO, 50V (DISC)	1524-0360-001
C335	2-18PF, Trimmer	1517-0000-001
C336	36PF, 5%, NPO, 50V (DISC)	1524-0360-001
C337	2-18PF, Trimmer	1517-0000-001
C338	36PF, 5%, NPO, 50V (DISC)	1524-0360-001
C339	2-18PF, Trimmer	1517-0000-001
C340	36PF, 5%, NPO, 50V (DISC)	1524-0360-001
C341	2-18PF, Trimmer	1517-0000-001
C342	.1 mfd, 20%, 12V (DISC)	1502-0104-005
C358	390PF, 5%, 50V (MICA)	1506-0391-550
	COILS	
L301	Output, Antenna	1801-1244-700
L302	Output, Final	1801-1284-300
L303	Choke, RF Final (Collector)	1803-3189-800
L304	Choke, RF Final (Base)	1803-1245-900
L305	Input, Final	1801-1276-000
L306	Modulator, Phase (13MHz)	1800-1251-800
T301	Bridge, VSWR	1800-1244-800
T302	Output, Driver	1800-1244-500
T303	Output, Pre-driver (156MHz)	1800-3166-300
T304	Output, Doubler (78MHz)	1800-3166-200
T305	Output, Tripler (39 MHz)	1800-3166-100
E301	Bead, Ferrite	2502-0000-001
E302	Bead, Ferrite	2502-0000-001
E303	Bead, Ferrite	2502-0000-001
E304	Bead, Ferrite	2502-0000-001
	DIODES	
CR301	Silicon, Signal	4805-1241-200
CR302	Varactor, SMV1172	4809-0000-001
CR303	Varactor, SMV1172	4809-0000-001
CR304	Zener, 8.2V, 5%, ½W	4808-0000-013
CR305	Zener, 6.0V, 5%, ½W	4808-0000-012
	TRANSISTORS	
Q301	Final RF Power (BTH - 204)	4804-3173-304
*Q301	Final RF Power (BTH - 204H)	4804-3173-302
Q302	Driver, RF Power	4804-3169-603
Q303	Pre-driver, RF Power	4804-3169-605
Q304	Silicon, NPN	4801-0000-010
Q305	Silicon, NPN	4801-0000-005
Q306	Silicon, NPN	4801-0000-003
Q307	Silicon, NPN	4801-0000-003
Q308	Silicon, NPN	4801-0000-003
Q309	Silicon, NPN	4801-0000-010
Q310	Silicon, NPN	4802-0000-002

*Indicates values used in BTH-204H

5-5 CHASSIS ASSEMBLY

Item	Description	Part No.
	ELECTRICAL COMPONENTS	
R1	5K, Volume Control/switch SW-1	4750-3211-201
R2	7.5K, Squelch Control	4750-3211-202
R3	680 ohm, 10%, ¼W	4701-0681-042
C1	15PF, 10%, NPO, 500V (DISC))	1500-0150-605
C2	15PF, 10%, NPO, 500V (DISC)	1500-0150-605
C3	15PF, 10%, NPO, 500V (DISC)	1500-0150-605
C4	.05 mfd, +80 - 20%, 25V (DISC)	1501-0503-004
C5	100 mfd, 10V, 85°C (Electrolytic)	1511-0101-001
C6	.047 mfd, 10%, 100V (Mylar Film)	1508-0473-610
C7	.001 mfd, +80 - 20%, 50V (DISC)	1503-0102-003
CR1	Diode, Silicon, Rectifier	4806-0000-004
RY-1	Relay, 3PDT, 12V (T/R)	4500-0000-004
SPK-1	Speaker, 3.2 ohm, 4 in. sq. (with mounting brackets)	7011-1069-100
SW201	Switch, PC Mount (Receive)	7011-1069-200
SW301	Switch, PC Mount (Transmit)	7011-1069-300
TB-1	Terminal Board, 4-lug	2103-3007-914
Y200	Crystal, Receive (Specify Frequency)	2311-0000-000
Y300	Crystal, Transmit (Specify Frequency)	2312-0000-000
F1	Fuse, 5 AMP, 3AG	5106-0000-008
J1	Connector, Antenna (Chassis)	2105-0000-020
J2	Connector, Microphone (Chassis)	2105-0000-021
P1	Connector, Power (Chassis)	2104-0000-004
P2	Connector, Microphone (Cable)	2104-0000-001
S1	Connector, Power (Cable)	2108-0000-001
	Socket Pins, Crystal Mounting	2830-0000-004
	DC Power Cord Assembly	7011-1037-901
	Microphone Assembly (with connector)	7011-1060-300
	Microphone, Ceramic (no connector)	1300-5080-902
	MECHANICAL COMPONENTS	
	Detent, 4- position (Rotary Switch)	5105-1219-809
	Heat Sink, Driver Transistor	5400-0000-002
	Heat Sink, Final Transistor	5400-3211-800
	Bracket, Relay Mounting	1400-3211-100
	Front Panel Bezel (Chrome)	1405-5081-301
	Faceplate (BTH - 204)	2403-5106-500
	*Faceplate (BTH - 204H)	2403-5114-300
	Knob, Channel Selector	2402-1268-900
	Knob, Volume and squelch	2402-1276-202
	Cabinet (Wrap) Assembly	1408-6033-301
	Foot, Rubber	1402-0000-001
	Bracket, Mobile Mounting	1400-3143-100
	Bracket, Security (less lock)	1400-1241-500
	Hanger, Microphone	2830-0000-003
	Hardware Kit, Mounting (bolts, washers, security bracket, mic hanger)	7011-1051-300
	Manual, Owner's Instruction (BTH - 204)	7001-1051-500
	*Manual, Owner's Instruction (BTH - 204H)	7001-1063-800
	Manual Service ($5.00 prepaid)	SM-10-515